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Mariners Weather Log

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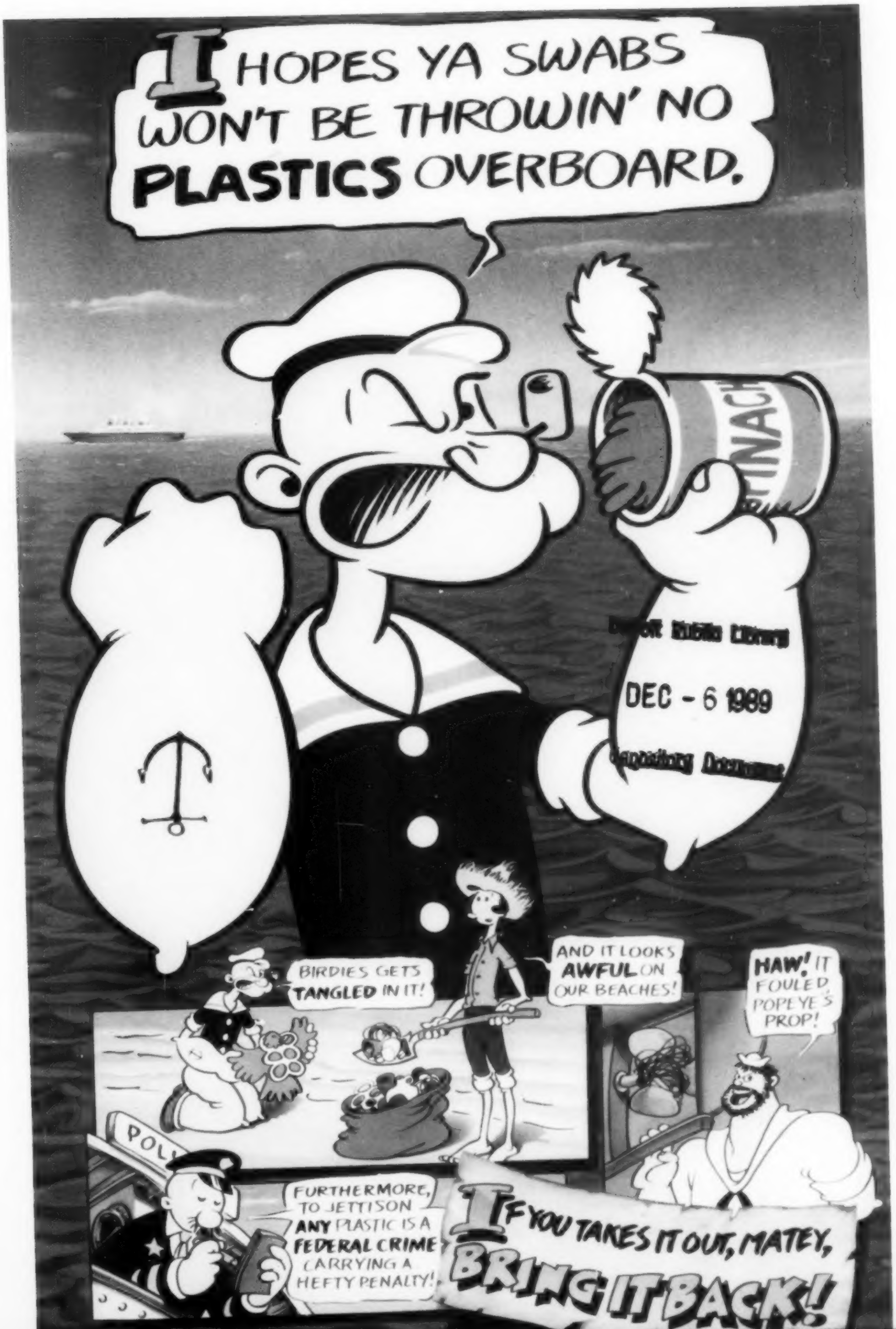
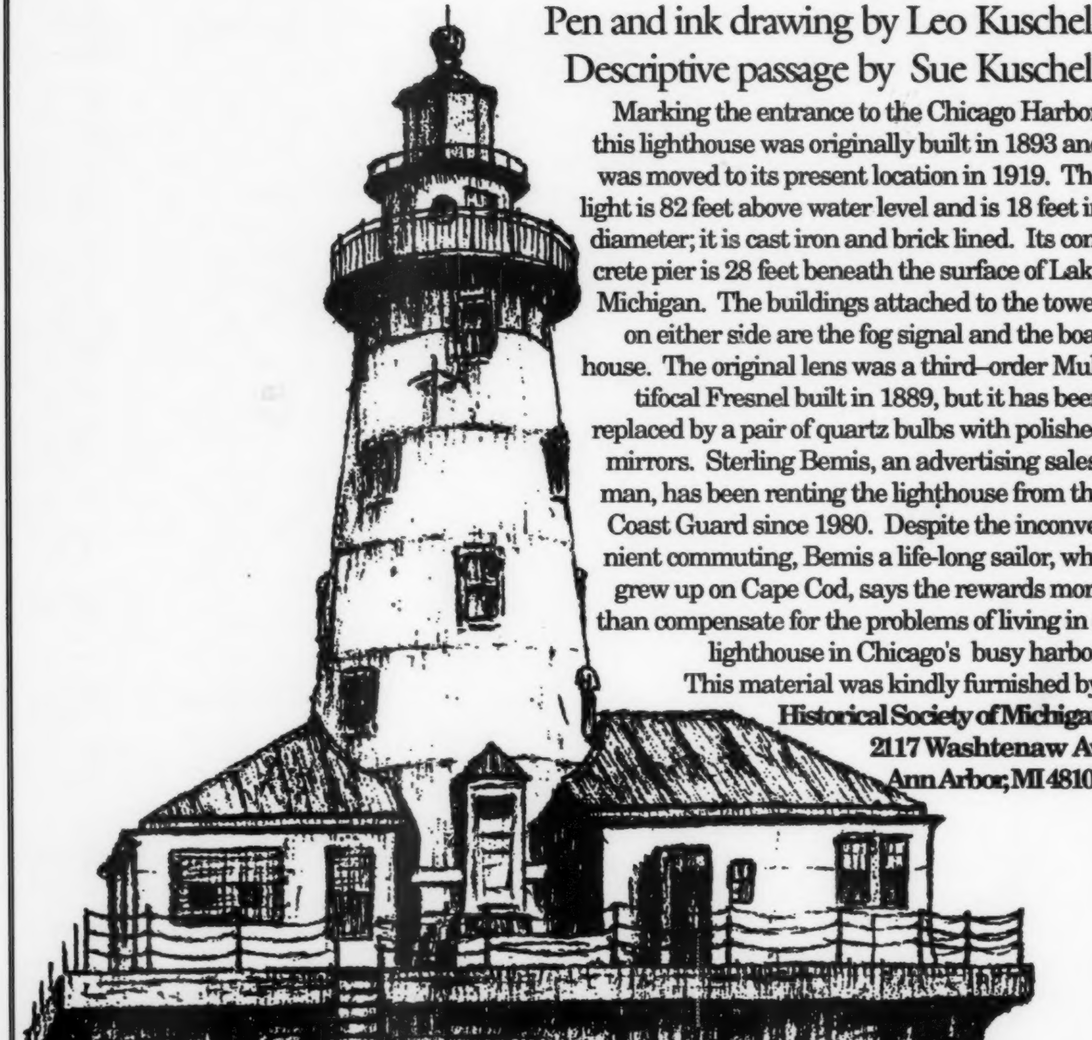


Chicago Harbor Light House

Lake Michigan, Illinois

Pen and ink drawing by Leo Kuschel

Descriptive passage by Sue Kuschel



Marking the entrance to the Chicago Harbor, this lighthouse was originally built in 1893 and was moved to its present location in 1919. The light is 82 feet above water level and is 18 feet in diameter; it is cast iron and brick lined. Its concrete pier is 28 feet beneath the surface of Lake Michigan. The buildings attached to the tower on either side are the fog signal and the boat house. The original lens was a third–order Multifocal Fresnel built in 1889, but it has been replaced by a pair of quartz bulbs with polished mirrors. Sterling Bemis, an advertising salesman, has been renting the lighthouse from the Coast Guard since 1980. Despite the inconvenient commuting, Bemis a life-long sailor, who grew up on Cape Cod, says the rewards more than compensate for the problems of living in a lighthouse in Chicago's busy harbor.

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Mariners Weather Log

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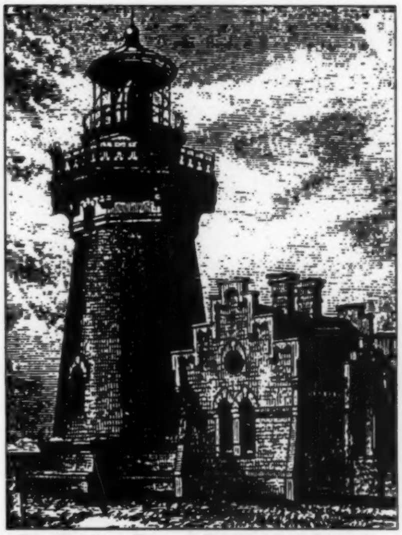
Features

Cover: Popeye and friends illustrate a growing problem to the seas in which we work and play (page 12). The cover, produced by the Center for Marine Conservation, is available as a full color poster (page 17). The Popeye family, © 1989, King Features Syndicate, Inc., was used with their kind permission.

Back Cover: The S/L *China Sea* is one of nine Sealift Class ships operated by Marine Transport Lines for the Military Sealift Command. It played a key role in the dramatic rescue of 17 Taiwanese crewmen in the South China Sea (page 2).



The Piedras Blanca Light (California) is an example of the varied architectural designs that have made lighthouses an enduring treasure. This is an engraving from ***Harpers Weekly*** *before the turn of the century. The article is on page 6.*

Editor: Richard M. DeAngelis

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Marine Weather Review

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On November 4, 1988 they battled wind and wave for a

China Sea Rescue

Captain Joseph C. Mullally II
Illustrations by Frank Braynard

On a dark, moonless, autumn night as the ***S/L China Sea*** steamed for the southern tip of Taiwan an **SOS** came in via Kao– Hsuing radio, Taiwan. The ***Golden Park*** was in trouble. The region lay in the grip of the Northeast Monsoon intensified by tropical storms Skip and Tess. (The following is a lightly edited account of the events of a dramatic rescue on November 4, 1988. Times are local, some are approximate.)

At 1820, ***China Sea's*** position was 20° 42' N, 120° 08' E. Radar showed the ***Golden Park*** at 20° 32' N, 120° 39'E. She reported making 3 knots, with a 20° list to starboard, which was increasing. She had a load of logs on deck as well as in the holds, but the deck load (when I saw it later) had not shifted, nor was it excessively high — maybe 5 feet above main deck. Its chain lashings were intact until after we arrived on the scene.

The Captain thought he was taking water but was not sure since all sounding tubes were on the low side and could not be reached. He was asking the ***Samrat Ashok***, standing by 3 miles on her port quarter, to remain until daylight at which time he would abandon ship.

An attempt at VHF radio contact did not work so the ***Samrat Ashok*** relayed traffic back and forth. I made it clear that I would proceed to the site, escort until daylight and, when it came time to abandon ship, would rescue personnel.

About a half hour later, the ***Golden Park's*** captain reported he had lost the main engine and could no longer maneuver. This left him broadside to the sea, with his low side to windward.

Hearing that we were a loaded tanker, he revised his plans. Knowing I was over 2 hours away but with his list increasing, he decided to abandon ship when I got there; his list was 40° by the time I arrived. I urged him to wait until daylight, if possible, but he did not think it was. I then asked him to wait long enough for me to maneuver in order to give his vessel a good lee from wind and sea and, for us to fire a line across to him.

I got no response and never heard from him again.

My setup was from port bridge wing down to the after R.A.S. deck, since seas were too heavy to safely reach the main deck. This cut us off from most of our normal equipment, like heaving lines and pilot ladders. Our crew had rigged our port lifeboat embarkation ladder for boarding survivors. Their Captain said he could launch the starboard lifeboat and one usable liferaft. I asked him to wait for my line, get everyone into the raft and my people would pull all of his across between the vessels. He agreed.

I made the fastest and nearest approach possible and gave him a lee immediately. I went a bit beyond my planned point, but the ***China Sea*** started to pick up stern way. I was backing to his vessel quite well, in good control of our situation. I asked him to wait for me to get in position and fire the line to him. I got no response and never heard from him again.

Maneuvering to get closer, I saw a man with a light go into the sea and make for us. The liferaft had also been launched without warning. The single man closed the short distance quite rapidly and my crew, who had now gotten to the main deck, quickly got a line to him and pulled him amidships to the pilot ladder. He came aboard in good shape and said that all the other men were in the liferaft, which was now clear of the stricken vessel .

In 15–foot seas the Golden Park crew continued to abandon ship singly and in small groups.

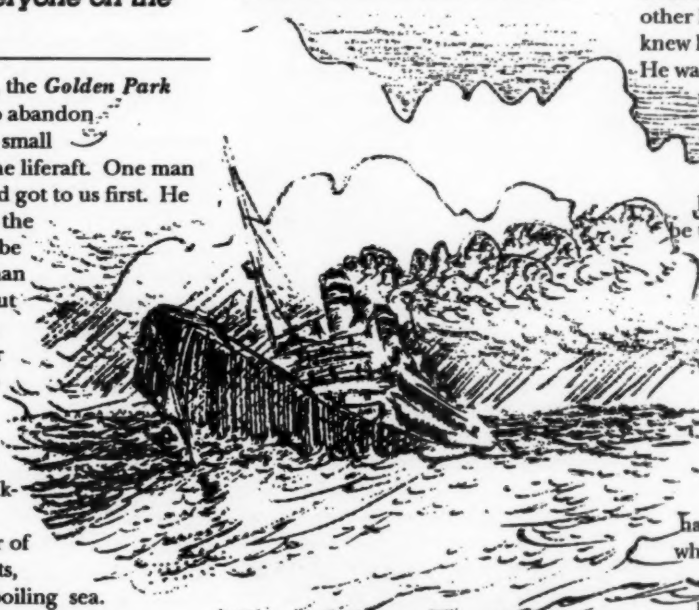
This turned out to be not true. As we maneuvered for the liferaft, suddenly more crewmen jumped in the water and started to seaward. I made some headway to get them before they crossed my bow, and several men were recovered on the port (lee) side but one got across the bow. I could not get him on the weather side and had to make a choice of him or the liferaft, which had capsized and was floating upside down. I went for the liferaft and asked the ***Samrat Ashok*** to pick up the man to seaward, who had a light. Two other lights crossed our bow, but David Patraiko, 2/Mate, was close enough to them to see there were no men. The Ashok never found the other man and we never found his light or saw his body during two searches of that area.

Suddenly a monster wave came from nowhere knocking down everyone on the deck.

In 15–foot seas, the ***Golden Park*** crew continued to abandon ship singly and in small groups. We got the liferaft. One man swam free of it and got to us first. He then assisted with the raft. It could not be righted but this man went down and cut the bottom open, allowing the other two men inside to escape. The ***China Sea*** was now less than 100 feet from the stricken vessel.

A whole cluster of men, with no lights, jumped into the boiling sea. They were backlit, in 40–knot winds, by the ***Golden Park's*** deck lights, which were still bright. I maneuvered ahead but two got across the bow. My men attempted to recover them anyway. They had a line on them with a life ring but were on the windward side. The pilot ladder had been rigged there as well. All were waiting for a wave to get them high on the side. Suddenly a monster wave came from nowhere knocking down everyone on the deck. It came green above the hose rub rail, carrying one man with it. When it receded it smashed him down on top of the rub rail, onto the knife–edge of the sheer strake and then back overboard. The man who was with him was little better off. He hit either the side of the ship or the pilot ladder and bounced off. Both were obviously hurt badly. The rest of the cluster of men went to seaward. By this time we were almost colliding with the ***Golden Park.***

I backed and filled twice to get clear. On the second try, I picked up too much headway; serious collision was inevitable if I tried backing. I thought the vessel was swinging clear and gave it everything I could on hard right wheel, full ahead. Just as it looked like the maneuver would succeed, a heavy sea struck my starboard bow and drove it to port. The same wave caused the stern of the ***Golden Park*** to rise and strike my port bow, though not very hard. I kept the swing going and had about 4 feet between the ***Golden Park*** and my port side. As his starboard quarter got to my amidships area, I reversed the wheel in stages ending with hard left, which kicked the stern about 30 feet off the other vessel. Michael O'Connell reported that he saw two men alive on the vessel as we swung clear.



One was obviously dead, floating face down with ... a large shark bite.

I continued the search. Almost immediately, we picked up five men. Three were roped together. One was obviously dead, floating face down with two large lacerations and (reported by Roberto Borras) a large shark bite. I recognized him as the man who bounced off our rail and deck. The other had to be the man with him. I knew he'd been injured on our hull. He was moving but in bad shape. I maneuvered to get him to the pilot ladder and the Chief Mate, Shannon Smith, got a line on him and he was hauled aboard. It turned out to be their Captain. He was given mouth–to– mouth by the Mate but it looked as if his heart failed and he died. The body with the shark bite was left, since I was not going to risk a live man for an obviously dead one.

While we were maneuvering and recovering people, half the ***Golden Park's*** deck load of hardwood logs had let go. The first indication was when they started hitting the hull on the starboard side. We saw no more people in the water so I moved to get away from the logs and protect the screw. Our starboard blinker light picked up the lifeboat, which had broken loose and was among the logs on our starboard quarter. We asked the ***Samrat Ashok*** to look in that area but nothing came of it. We searched for lights but saw only the

two that had no men.

Swinging back to the stern of the ***Golden Park***, I saw one man aboard but he quickly disappeared. We did not see him in the water. He may have gone to get the other man who was spotted earlier. I did not wait but went seaward to search for at least one man I knew was out there. All we found were the two unaccompanied lights, the unlit lifeboat and two liferings. The lifeboat, with no people, was half full of water.

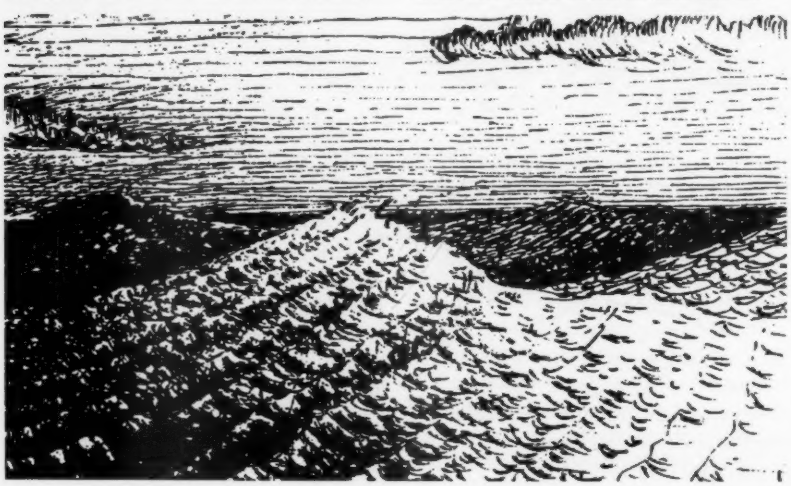
...the Golden Park either capsized, sunk or both.

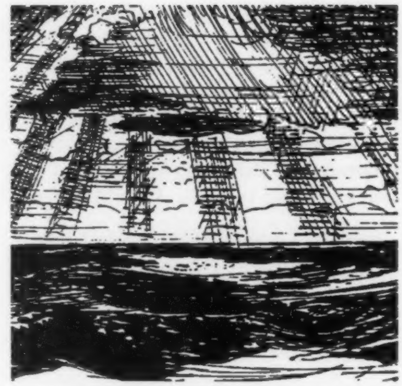
Their Chief Mate was summoned to my bridge so he could speak, in Chinese, to anyone left aboard the ***Golden Park*** on our VHF. He also reported that 18 men had been rescued , including their Captain. We knew two were with the ship and one was dead in the water; so that left one man alive in the water. As I maneuvered alongside the last light, which turned out to be unaccompanied, the ***Golden Park*** either capsized or sunk or both. This occurred at about 0330 on the 5th. I was concentrating on the light and the water, but the ***Samrat Ashok*** asked if I knew where it was. I thought so since we had two vessels on radar, but the second was the ***Hand Gate***, sister vessel to the ***Golden Park***, which had come to assist in the search. It was then only 2 hours or so until daylight. A further search was impossible since, if the ship had merely capsized and was floating upside down, a serious collision could have resulted. Seas, which were reaching 25 feet at times, were rough enough so that no radar target would show.

Some of the the survivors were injured. Shannon Smith reported three possible concussions, one head laceration needing stitches and one bad ankle, probably not broken. Three men had to be revived with mouth–to–mouth and two were then given oxygen. The third was the Captain. The first two were alive and well thanks to Stanley Emmanuels, 2nd A/E and Peter Kinnin, 3rd Mate. These two men together handled most of the medical duties, assisted by Smith and some of the Chinese.

With two vessels on the scene to make a daylight search, I got permission from the ***Hand Gate*** to leave for Kao–Hsuing, the nearest port. We secured for sea and left at about 0600 on the 5th. Arriving at Kao–Hsuing at 1700 that same day , we gave officials a preliminary report and left again at 1830.

Everyone on the ***China Sea*** did a tremendous job. Some kept lookout, like Anthony Flores, G.V.A. and Michael O'Connell, 3rd A/E, helping to spot men who might otherwise have been lost. Leon Satterthwaite did an





excellent job as quartermaster, never making a single error through the operation. William Pearce. R.E.O., Newton Martin and Robert Cheney, A.B.'s manned blinker lights, being used as spots, and acted as lookouts. Often these lights were the only means of sighting survivors. When not needed there they went to the main deck to pull people aboard.

Everyone worked as a team and cooperated with skill and alertness...

Roberto Borras, A.B. and Mark Broughton, A.B. brought about 10 survivors aboard, using an aluminum ladder —— the Chief Mate's idea. They would take it up and down the deck to where men were in the water. The survivor would grab the ladder and they would haul him aboard.

Shannon Smith, Chief Mate, went in the water twice and brought a man back each time. David Patraiko, 2/Mate, was excellent as a lookout on the bow and assisted in survivor recovery. They were assisted by Dennis Gaffney, Bosun, Jose Poses and Frederico Longoria, G.V.A.'s, Peter Moore, 1st A/E, and the A.B.'s previously mentioned. Michael Brugh, Chief Engineer, operated the plant by himself, allowing the other Engineers to assist topside.

Herman Shorter, Roosevelt Johnson and Mario Garcia, Steward, Cook and Utility, assisted with the wounded and in general provided for the survivors.

1989 American Merchant Marine Seamanship Trophy

For his role in the rescue of the the 17 Taiwancse seamen in the South China Sea in November of 1988, Captain Joseph C. Mullally was awarded the 1989 American Merchant Marine Seamanship Trophy. Captain Mullally, received the silver trophy from deputy secretary of transportation Elaine L. Chao at the annual Admiral of the Ocean Sea dinner in New York City on September 15, 1989. The Seamanship Trophy's citation reads: **The extraordinary seamanship skills of Capt. Mullally and the heroic, persistent and gallant efforts of his crew under extreme weather conditions uphold the highest traditions of the sea. In saving human life and in the demonstration of the most excellent qualities of seamanship, Capt. Mullally and the crew of the USNS SEALIFT CHINA SEA qualify as winners of the American Merchant Marine Seamanship Trophy.**

A plaque bearing these words was presented to Capt. Mullally.

The Seamanship Trophy was established in 1962 by the U.S. maritime community to honor acts of distinguished seamanship by American citizens. It is not necessarily given every year. This was the 20th award in the series. The trophy will go on display at the American Merchant Marine Museum at the U.S. Merchant Marine Academy, Kings Point, NY.

Everyone worked as a team and cooperated with skill and alertness to turn a chaotic situation from total disaster to at least partial success.

They had to depend upon flashlights, lanterns and the like...which did not stand up well to the sea.

The conditions for this rescue were a dark, moonless night, 40–knot winds and average seas of 15 feet. The highest seas breaking on the vessel were 25 feet; one struck after the operation was over and the deck clear. It came over the after R.A.S. deck two feet deep and swept across it and the main deck 10 feet below. The sea that killed the man with the Captain, and probably the Captain, was about 20 feet.

The worst aspect of this search and rescue was the fact that the *Golden Park* was not equipped like U.S. vessels. None of the lifejackets that these men depended upon had either reflective tape, reflective panels or personnel marker lights. They had to depend upon flashlights, lanterns and the like, which were limited in number and did not stand up well to the sea. We had to depend upon spotting a face or orange lifejacket in the sea with our blinker lights in many cases.

Peter Kinnon made two good shots with the shotlines but they fell short and no one made an effort to grab them, especially the second one which was near the liferaft. After that, there were no good places to land a line. Walkie–talkies were critical, allowing communication and coordination of efforts and they performed well.

The Chief Mate of the *Golden Park* was a great help during and after the rescue. All his men, who were in condition to do so, assisted; some went back in the water to help their shipmates.

On a sad final note, I was told in Kao–Hsuing that neither of the remaining vessels found any more survivors. It is probable that the ship went down or capsized so suddenly that the two men left aboard went with it. The only other man known alive and in the water was not found when last I heard. The total number of crewmen aboard the *Golden Park* was 22 of whom 17 arrived in Kao–Hsuing along with the Captain's body.

This is the second of a two-part lighthouse history to celebrate the 200th Anniversary of America's Lighthouse Service.

Sentinels on Watch—2

Elinor DeWire

Laurence Arnold

Up until the mid-1800s, lighthouse construction confined itself to onshore sites or solid submarine and wave-washed foundations, but the need for sentinels on unstable foundations, such as mucky river estuaries, erosive beaches and coral reefs, had grown paramount. Places like the Florida Keys, the Chesapeake and Delaware Bays, and the alluvial Gulf Coast desperately needed to be marked, yet heavy masonry towers could not be adequately anchored on such unstable surfaces.

Again, Britain would find a solution to the problem. Experimenting with wharf pilings, a blind engineer named Alexander Mitchell came up with a type of anchorage called the screwpile and successfully used it in the mucky estuary at Maplin Sands, England. Mitchell's Maplin Sands Lighthouse looked like a giant spider standing knee-deep in the water. It consisted of a small house and lantern atop eight iron piles which were literally screwed through the silt and anchored in solid bedrock. Mitchell's lighthouse was a phenomenal success, spurring engineers throughout Europe and the United States to design similar systems.

Two problem's quickly became apparent with this new design; the threat of collision by ships off course and, in northern areas, by floating chunks of ice.

In the southeastern U.S. and Gulf of Mexico, the screwpile and its variations were ideally adapted to the Florida Reef and the continually shifting beaches between North Carolina and Texas. Mid–Atlantic bays and sounds also benefited. Five huge towers of screwpile design were built on the Florida Reef between 1840 and 1880, requiring special stabilizing discs where their piles entered the coral. Each tower was of open framework design to allow hurricane wind and waves to pass through unimpeded. Sturdy keepers' quarters were incorporated into the towers at suitable heights above the water, and state–of–the–art optics were installed in their lofty lanterns.

In less tempestuous bays, estuaries, and sounds, the screwpile design featured a small house, low to the water and sitting on deeply anchored pile legs. Two problems quickly became apparent with this new design; the threat of collision by ships off course and, in northern areas, by floating chunks of ice. This was solved in the 1880s when Major David Heap of the Army Corps of Engineers designed and built the first caisson lighthouse at Fourteen Foot Bank in the Delaware Bay.

This design proved so successful, it replaced most screwpile lighthouses north of Florida.

Heap's caisson was a 73–foot vertical iron cylinder of 35 feet in diameter, fabricated onshore, towed to the site, and sunk in the bay bed. Seawater was vacuumed out to allow workmen to prepare the foundation, then it was filled with concrete and riprap, and the iron sheathing was removed. Riprap was also placed around the base to fortify the caisson. The superstructure included a two–story cast–iron dwelling with a lantern projecting from its roof and a Daboll fog trumpet in its basement. Later, hollow caissons were prefabricated ashore, then towed to their sites to be sunk and filled. This design proved so successful, it replaced most screwpile lighthouses north of Florida.

One of the most difficult caisson lighthouses to build was Race Rock Light in Long Island Sound, situated at the eastern edge of the perilous current caused by the tides roaring through the opening between Fishers Island and Great Gull Island. The sentinel was constructed by F. Hopkinson Smith, who also built the massive foundation for the Statue of Liberty— herself originally a lighthouse.

First, Smith created a plinth with a mass of concrete 60 feet across that was poured in four concentric layers using large iron hoops. A second pier, smaller in diameter, was poured over this to a height 30–feet above the foundation. The entire base was then reinforced by the addition of 10,000 tons of riprap,

Elinor DeWire

Top left is the screwpile light so popular in the South. This is the American Shoal Lighthouse in Florida's waters. Thomas Point Light (previous page) can be seen in the Chesapeake Bay. In addition to a fog signal the light also has special radio direction–finder equipment. An example (above) of a caisson style lighthouse is Fourteen Foot Bank in the Delaware Bay. The caisson is a 73–foot vertical cylinder some 35 feet in diameter. Race Rock Light in Long Island Sound (below) was one of the most difficult caisson lighthouses to build.

Elinor DeWire

Elinor DeWire

and the superstructure, consisting of a granite dwelling with a tower rising from it, was completed in time for the beacon to be exhibited on New Year's Day, 1879.

This design [collapsible] provides for fast and inexpensive dismantling, moving and reassembling— something akin to our modern modular and prefab buildings.

Almost simultaneously, lighthouse architects and engineers ingeniously solved another problem related to instability. In areas where beaches were hardpacked enough to support massive concrete foundations, but erosion was rapid and unpredictable, the collapsible lighthouse was put to the test. This design provides for fast and inexpensive dismantling, moving, and reassembling of lighthouses—somewhat akin to our modern modular and prefab buildings.

The central feature of this design was a series of cast–iron plates, which were bolted together on a concrete foundation and stabilized with a lining of bricks. In addition, the stairway and lantern could also be assembled or dismantled in pieces. Such forms proved ideal in the Southeast, where beach topography is constantly in flux.

Hunting Island Lighthouse near Frogmore, South Carolina is typical of this design. Its original masonry tower toppled due to undermining and was replaced by a collapsible structure in 1875. After erosion changed the shape of the beach in 1889, this tower was dismantled and relocated to a more effective site. Cape Canaveral Lighthouse in Florida is similar in design to Hunting Island Light and has also been moved since its original construction in the 1870s.

Point Arena, CA had a masonry lighthouse at the turn of the century that was destroyed in the Great San Francisco Earthquake of 1906.

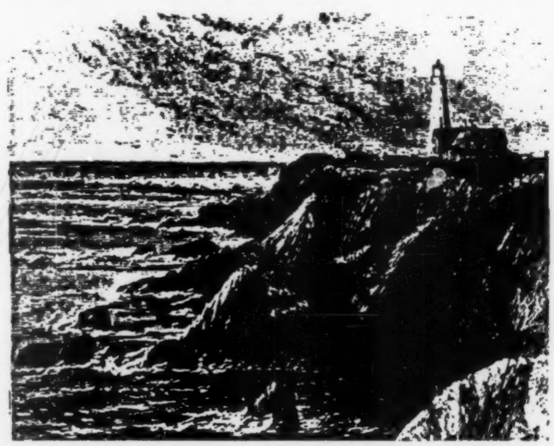
Several other natural hazards have necessitated special lighthouse designs. In Northern California, where the San Andreas Fault runs close to shore, reinforced concrete towers are in use to thwart possible collapse from earthquakes. Point Arena, CA had a masonry lighthouse at the turn of the century that was destroyed in the Great San Francisco Earthquake of 1906. For construction of the second tower, the government hired a firm specializing in industrial chimney construction. A new lighthouse was built of reinforced concrete strengthened by massive cement buttresses at its base. Special cushioning in the foundation allows the tower to sway 3–feet from vertical in high winds or severe earthquakes. So far, the structure has not been tested by more than small tremors, but engineers feel it could withstand another catastrophe of the 1906 magnitude.

Certain familiar features of lighthouses, regardless of their beauty, function as navigational aids and are intentional elements of design.

Lightning rods are a must on all lighthouses, though for a time early Colonists refused to use them, citing their interference with divine strokes of power. After Boston Lighthouse was struck and damaged by lightning several times, it was agreed such a lofty structure tempted the powers of heaven too much, and a lightning rod was installed.

Certain familiar features of lighthouses, regardless of their beauty, function as navigational aids and are intentional elements of design. Daymarks are as important to lighthouses as their beacons and constitute all aspects of a tower's visual appearance. Descriptions of lighthouses in Coast Guard Light Lists include shape (cylindrical, conical, truncated, telescoping, pyramidal, square, etc.), height, and color.

The height of a lighthouse is dependent upon its required visible range and



Hunting Island Lighthouse (top left) is typical of the collapsible design. It was built in 1875 and, after erosion, the tower was dsimantled and moved to a more practical site in 1889. The original Pt. Arena, CA Light (left) was a masonry structure that was destroyed by the San Francisco Earthquake in 1906. Its replacement survived the San Francisco Earthquake of 1989 as did the Pigeon Pt. Light, which was closest to the epicenter.

the elevation of its base. In the case of landfall lighthouses, those built on high headlands and promontories require little additional height to elevate the beacon's focal plane. They are likely to be short and squat to create stability and prevent wind damage. Landfall lighthouses built on low, flat beaches or at the waterline require height and slenderness to elevate the light's focal plane and reduce excessive weight.

Entryways to lighthouses vary considerably with location, climate, and overall design.

Color is equally dependent on function and physical surroundings. White or beige beaches require dark–colored lighthouses. Heavily forested or snowy areas need bright markings, usually red. Stripes, diamonds, checkers, and other comely designs arise when neighboring lighthouses need differentiation. For example, along North Carolina's Outer Banks this progression of colorful daymarks is found; Black and white checkers, all red, black and white horizontal stripes, black and white spiral stripes, all white, and black and white diamonds. Additionally, sentinels in channels and harbors must conform to the color schemes of navigation, such as red on right returning.

Entryways to lighthouses vary considerably with location, climate, and overall design. In the heyday of lighthouse keeping, the New England lighthouse often had a covered passageway connecting the keeper's dwelling to the tower. Equally, a footbridge connected the tower with the shore if it stood below the high tide mark. Where towers were incorporated into the plan of the keeper's dwelling, a small rotunda, foyer, or storage room usually stood at the base of the stairwell. Most lighthouses, however, were separated from keepers' dwellings and had their own entry on the leeward side.

John Terry

Gallery railings also presented architects with opportunities for the aesthetic touch. Many are ornate, especially the circular balustrade at Cape Neddick Lighthouse, ME (left), which has a miniature lighthouse on each railing post. Here Karyn Terry is seen entertaining her pets.

Doors and windows are among the possibilities for exterior ornament on a lighthouse; hence architects often embellished them with elegant hoods and lentils. Porthole–style windows and eyelets are often seen, and many of the house–type sentinels sport gabled windows. Lantern windows vary greatly in design, but must attend to the function of emitting a clean, unobscured beam. Latticework in the frame facilitates drainage and snow removal, however, the majority of lighthouses have horizontal lantern framing with handholds built into the frames to aid in cleaning the windows at perilous heights.

Brackets supporting the lantern can be very handsome additions. Florida's Reef Lights, often criticized for their cold, stark ironwork, still exhibit Antebellum beauty in their delicate, scrolled brackets.

Numerous stairway styles can be found in lighthouses. Most sentinels have wrought iron staircases bolted or bracketed to the interior walls. These may be continuous steps or interspersed with landings at which windows appear. Given the dominance of the conical shape in lighthouse architecture, most staircases are spiral, but many forms exist. Pile design lighthouses usually have a central stair cylinder that is very narrow, cramped, and dark. Wooden stairs are common in many house–type sentinels, and a few rare stone staircases still exist, including the fine examples at Stonington

Lighthouse in Connecticut and Florida's Amelia Island Lighthouse.

Arrangement of the upper portion of light towers depends on the size and type of machinery employed to operate the beacon. In the years prior to electricity, huge weights were suspended in the tower to power the light's revolving mechanism, and a large pedestal for the lens was incorporated into the watchroom, just below the lantern. When electric motors took over the tasks of revolving the light, the clockworks and weights became obsolete, and generators were installed in the watchroom. Today, one can also find devices such as timers, photosensitive cells, solar batteries, and bulb changers to perform the functions of lightkeeping automatically.

Few structures transcend time, place and culture, or so perfectly capture the benevolent ideas of mankind the way a lighthouse does ...

The last *traditional* lighthouse was built in 1928 at Point Vincente, CA— a concrete cylinder with a hint of Spanish architecture in keeping with the nearby Palos Verdes Estates. More modern pyramidal lighthouses were built in Hawaii in the 1930s, with sleek lines and self-sufficient beacons, but they lacked the conventional look by then familiar to lighthouse enthusiasts.

The most recent sentinels, and no doubt the last of their kind, are the ultra-modern Sullivans Island Lighthouse at Charleston, SC and Oak Island Lighthouse near Wilmington, NC. Sullivans Island Light (right), built in 1962, is a triangular tower of steel coated in porcelain. It sits on a hexagonal base, has an elevator, and wields a 28-million candlepower beacon. Except for minor flooding, it recently withstood the ravages of one of the worst hurricanes of the century—Hugo. The 1968 Oak Island Lighthouse is a concrete cylinder with its daymark of buff, gray, and black poured directly into the concrete; thus it never needs repainting. It sits on a cushioned foundation to allow sway in high winds and has a dual-intensity beacon in its lantern. The beam's high-intensity function is capable of burning human skin and requires special insulation in its components and throughout the lantern room.

Elinor DeWire

It is unlikely that lighthouses, in the traditional sense, will ever be built again—a sad admission to progress—but as the lights are discontinued or automated, the Historic Preservation Act of 1966 ensures they fall into the loving care of new keepers. These preservationists view lighthouses as wholly unique structures and seek to preserve the important role they have played in history as well as the material remains of their active tenure.

Few structures transcend time, place, and culture, or so perfectly capture the benevolent ideals of mankind the way a lighthouse does; few have suffered more trauma and triumph in their evolution. Surely, none will ever again conjure the same kind of romance and excitement or embody such perfect solicitude.

When it's done holding your ship's garbage, it could hold death for some marine animals.

This plastic trash bag may not look like a jellyfish to you. But to a hungry sea turtle, it might. And when the turtle swallows an empty bag, the mistake becomes fatal.

The problem is more than bags. Plastic six-pack holders sometimes become lodged around the necks and bills of pelicans and other seabirds, ultimately strangling or starving them. Other plastic refuse, either through ingestion or entanglement, causes the deaths of thousands of seals, whales, dolphins and other marine mammals every year.

Plastic debris also causes costly and potentially hazardous delays to shipping when it fouls propellers or clogs intake ports.

It's a critical issue, destined to attract public and government scrutiny if we fail to take action to solve it.

So please, stow your trash, and alert your shipping terminals that you will need proper disposal on land. A sea turtle may not know any better. But now, you do!

To learn how you can help, write: Center for Environmental Education, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Will Troyer
U.S. Fish and Wildlife Service

Part 1 looked at the growing problem of plastic garbage in the oceans. We have a choice before it's too late to combat

Persistent Marine Debris

Part 2— The Solution

David Cottingham

The U.S. Navy routinely pitched trash from vessels at sea into the ocean at an alarming rate of almost 4 tons per day. After learning of the problems marine debris causes to marine wildlife the Navy decided to stop throwing plastics overboard.

Navy officials and representatives of 11 environmental groups tour aircraft carriers, destroyers and other vessels to determine practical ways to reduce wastes. These will require changes in the way galley crew and other sailors handle solid materials, the packaging of bulk supplies and new systems to treat wastes aboard.

As important as major steps like this are, backed by the Marine Plastic Pollution Research and Control Act, it is the individual, voluntary efforts by the mariner and others that will eventually lick this problem. Maybe then the health inspectors in Maryland will be able to stop using gloves, tongs and protective buckets to clean up syringes and bloody medical wastes that wash up on their beaches.

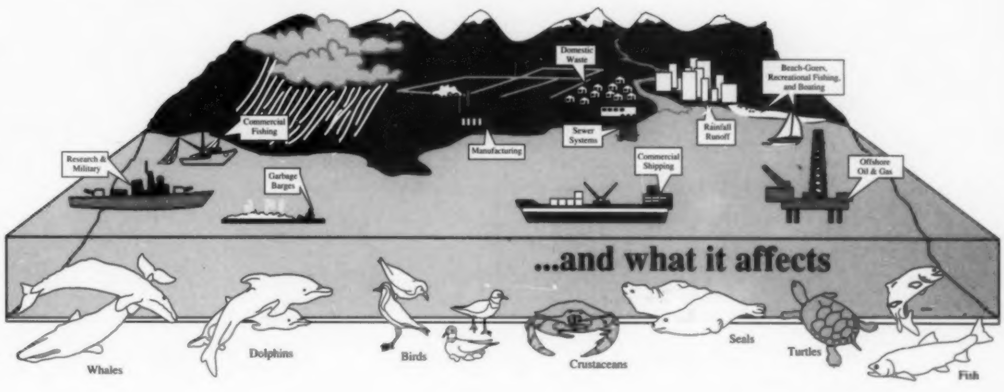
Positive efforts are being made. Industry associations, companies and public interest groups have organized beach clean–ups. Fishermen's organizations are educating members about the hazards of plastics. Ways of making and using degradable plastics are being explored. Oil companies are helping to clean Gulf Coast beaches. Attempts are being made to recover plastic pellets lost during manufacture. Recycled plastic is being used to produce a wood substitute.

David Cottingham, in the Ecology and Conservation Office under NOAA's Chief Scientist, served as chairman of the Interagency Task Force on Persistent Marine Debris. The Alaska Sea Grant Program was most helpful in the production of this series.

Waking Up

Litter on our coasts is an indication of even greater amounts in the ocean where it is less visible but deadly.

Where ocean debris comes from...



Big Brother

Over the past several years, the public's awareness of the marine debris problem has prompted action to combat the threat. Thousands of people around the world are working to stop the improper disposal of plastics and to clean cluttered beaches. Many federal agencies fund programs to track sources of marine debris and evaluate its effects on the marine environment.

Federal agencies sponsor and organize international and national education programs on persistent marine debris. These are aimed at industries and individuals who contribute to the problem, such as commercial and recreational fishermen, plastics manufacturers and transporters, and beach visitors.

NOAA's National Marine Fisheries Service and Sea Grant Program, and the National Park Service have developed slide shows, films, posters, and brochures explaining problems.

Take Pride in America is a public and private partnership between 9 federal agencies, 43 states, 2 U.S. territories and numerous private organizations. Its two major thrusts are public education and a national awards program for recognizing individuals and groups that conduct outstanding public awareness or stewardship activities.

Several federal agencies help develop and enforce regulations on plastic debris, while they also develop other ways to reduce the amount of persistent debris entering oceans and estuaries. EPA regulations implementing the Marine Protection, Research, and Sanctuaries Act (Ocean Dumping Act) and the Clean Water Act prohibit people from disposing of solid materials from land–based sources into the marine environment.

The U.S. Coast Guard directs the domestic section of MARPOL Annex V as passed in the Marine Plastic Pollution Research and Control Act. NOAA and the EPA are leading a nationwide public education effort concerning the persistent marine debris problem.

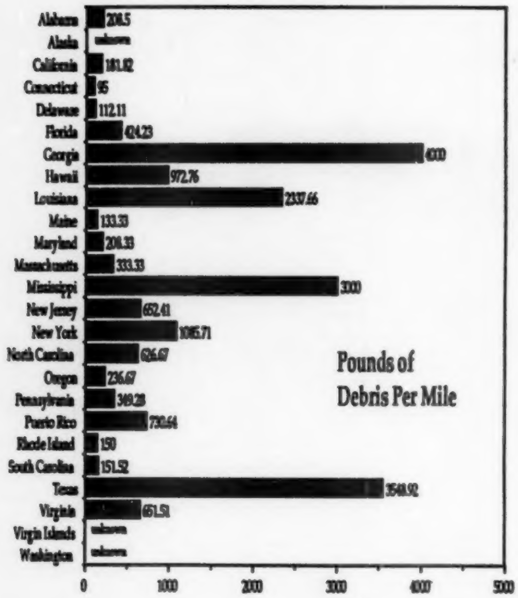
On December 31, 1988 an international treaty took effect that put a halt to the dumping of plastic garbage at sea, legally.

State and Local Efforts

Some 25 states reported that plastics were the most prevalent type of debris, ranging from 43.4 percent in Puerto Rico to a high of 94.5 percent in New Jersey.

State and local agencies across the country are leading campaigns to increase public awareness of problems caused by persistent marine debris. In 1984, the Oregon Department of Fish and Wildlife started local beach cleanups. The idea caught on and spread quickly. Several states, such as Texas and Louisiana, sponsored **"adopt–a–beach"** programs in which organizations recruited volunteers to clean stretches of beach. Today, government and private sector employees and citizen groups continue to coordinate these kinds of activities.

The Texas General Land Office has mobilized government and citizen sup-



The results of the 1988 National Beach Cleanup (left) were compiled by the Center for Marine Conservation. While methods used to weigh debris varied among each state,it is obvious that the Gulf of Mexico is a unique repository of marine debris, due to the infrequent flushing action of tides and currents and the concentration of marine traffic. The collection program at Newport, OR (below) is paying noticeable dividends.

port to keep their beaches clean. They have two beach clean–ups annually, each of which attracts over 7,000 volunteers. Among other things, local restaurants and motels provide discounts to volunteers from out of town.

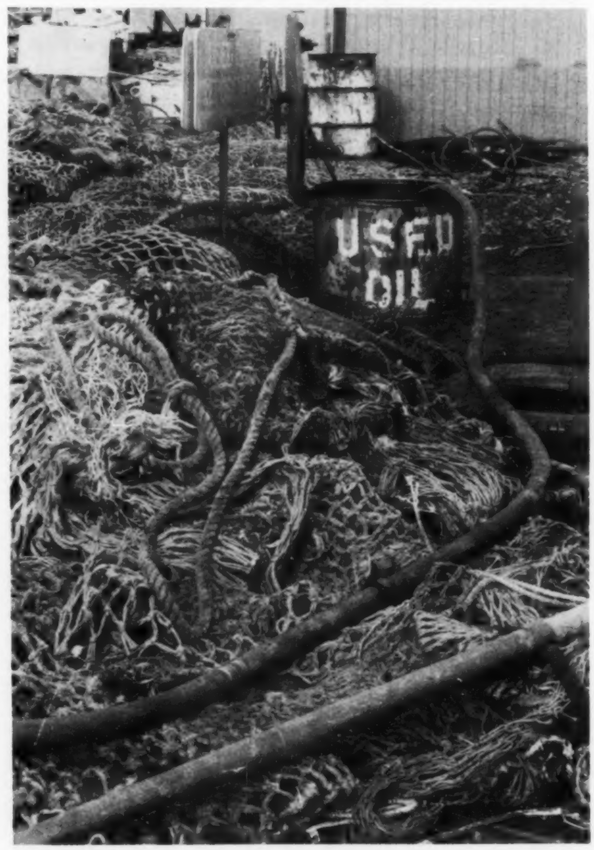
In some parts of the country tampon applicators are so common that people have jokingly named them beach whistles and New Jersey sea shells.

The New Jersey Department of Environmental Protection has adopted an aggressive program to reduce litter on its beaches, including beach clean–ups and helicopter overflights to determine sources of debris. A state–sponsored program entitled **"New Jersey Shore–Keep It Perfect"** is an anti–litter campaign to educate the public and encourage coastal communities to provide disposal facilities at beaches. The New Jersey legislature also passed a bill creating a marine police unit of 60 to 70 new officers based in the New York Harbor area to observe and enforce dumping regulations. New York and New Jersey are among several states that have enacted laws that regulate the disposal of medical wastes.

This action was spurred by a major debris wash–up in August 1987 that included medical waste, wood and glass. It was investigated by the New Jersey Department of Environmental Protection and the New Jersey Attorney General. The investigation blamed the solid waste handling, transfer and disposal procedures of New York City in the harbor areas as the major source of floating debris.

The Oregon Department of Fish and Wildlife has sponsored annual beach clean–ups since 1984, along with a campaign called **"Get the Drift and Bag It."** The port of Newport, Oregon, which serves about 600 fishing vessels and several thousand recreational craft, provides receptacles for different types of debris— synthetic nets, glass, cardboard, wood, and garbage. This arrangement encourages recycling and proper disposal, and demonstrates that proper handling can reduce the cost of solid waste disposal.

Beach clean–ups provide one of the best ways to monitor the volume and variety of litter that washes ashore. During **Coastweeks 1988**, over 47,000



Fran Recht

Beach Clean–ups

volunteers in ocean coast states picked up nearly 1000 tons of trash along beaches. The quantities of debris varied tremendously, from less than 95 pounds per mile in Connecticut to almost 2 tons per mile in Georgia. The proportion of ocean–source versus land–based debris varied with location, depending on proximity to harbors, fishing grounds, convenience stores, and other sources.

The Texas coast at Padre Island National Seashore (PINS) receives about 580 tons of marine debris per year— over 10 tons per mile.

Volunteers in the Massachusetts **Coastweeks 1988** beach clean–up collected almost 25 tons of debris along 150 miles of beach. The clean–up coordinator estimated that roughly 60 percent was left by beach visitors.

A survey of beaches on Amchitka Island, AK, showed that 85 to 98 percent by weight, and 70 to 81 percent by number of pieces of debris excluding small plastic fragments, originated from commercial fishing operations. Trawl webbing sometimes exceeded 950 pounds per mile.

Galley wastes were the most prevalent category of indicator items reported, accounting for approximately 7.8 percent of the trash collected nationwide. If these wastes were evenly distributed along the 3,518 miles of coastline that was cleaned, then at least 22 plastic garbage bags, 7 milk and water gallon jugs, 4 foamed plastic meat trays, 5 plastic bleach and cleaner bottles, 2 egg cartons and about 2 plastic vegetable sacks would be found on every beach mile.

Not all debris collected was trash. Several volunteers were rewarded for their efforts by finding treasure. The most valuable finds were a $100 bill in Texas, an uncashed bank check for $60 in Delaware and a diamond and amethyst necklace found by a girl scout in Florida. And for those who wonder if anyone finds those bottles with notes inside, volunteers reported finding eleven such messages including one note found in Connecticut from an author in France.

Private sector groups, including industry associations, individual companies, and public interest groups help organize beach clean–ups, sponsor public and industry awareness campaigns, and study degradable plastics technology. Many of these projects are joint efforts among industry, private citizens, public interest groups, and government agencies.

Fishermen's organizations in the North Pacific region, such as the Highliners Association, sponsor workshops and use posters and mailings to educate members about the hazards of discarding plastics into the ocean. North Pacific Rim fishermen sponsored an international conference on marine debris in 1987 in Kona, Hawaii. During that meeting, fishermen adopted guidelines governing fishing vessel activities.

The Dirty Dozen

The twelve most common debris items reported along our nation's coast in 1988:

1. *plastic pieces*
2. *styrofoam-like pieces*
3. *plastic eating utensils*
4. *metal beverage cans*
5. *styrofoam cups*
6. *glass beverage bottles*
7. *plastic caps and lids*
8. *paper pieces*
9. *plastic trash bags*
10. *miscellaneous plastic bags*
11. *glass pieces*
12. *plastic soda bottles*

Fran Recht

A project jointly funded by NOAA and the Port of Newport, OR in 1987–88 (above), was planned and carried out by the National Marine Fisheries Service, West Coast Trawl Fishermen, Oregon St. U. Sea Grant and the Port of Newport, with help from an advisory committee of over 20 public and private entities.

Private Initiative

The Society of the Plastics Industry, Inc. (SPI) sponsored a symposium that explored ways to make some plastics degradable. In conjunction with NOAA and the Center for Marine Conservation (CMC), SPI developed an ad campaign for trade journals geared toward recreational boaters, commercial fishermen, and the plastics industry, alerting them to the problems of plastics in the marine environment and what they can do about them.

Conoco, Texaco, Mobil and other oil companies... "adopted" and cleaned beaches...

Conoco, Texaco, Mobil, and other oil companies operating in the Gulf of Mexico "adopted" and cleaned portions of beaches in Texas and Louisiana during 1987 beach clean–ups. Under the umbrella of the Offshore Operators Committee, oil companies operating in the Gulf of Mexico produced video-

Oregon was in the fore-front of the beach clean–up movement. In 1984 the Oregon Department of Fish and Wildlife started organizing local programs and the idea caught on rapidly. Below, right, a Sandpiper forages on a Pacific shoreline, dependent on us for a clean environment. Alaska Sea Grant Photo.

Fran Recht

Both biodegradable and photodegradable plastics are commercially available. However these plastics do not just disappear— they merely break down into smaller and smaller plastic pieces. This use of degradable plastic may compound the problem of ingestion.

tapes on marine debris and included them in employee training programs.

Dow Chemical installed a collection system to recover plastic pellets that are lost during manufacture. Now, instead of entering the environment via the waste stream, the pellets are returned to the company.

Anheuser Busch announced that all six–pack yokes used on their products will be made of degradable plastic.

The Center for Plastic Recycling Research has developed a process which co–mingles recycled plastics and produces a lumber–like product that can be used as a substitute for wooden boards or posts.

Environmental Groups

The Center for Marine Conservation, a Washington, D C–based public interest group, promotes beach clean–ups around the country. It supports research techniques for saving entangled animals, and provides information and technical advice to Congress, federal and state agencies, and a variety of local organizations. CMC also serves as a clearinghouse for information on marine debris, including where to obtain public education information packets. Most of the quotes in the side columns were taken from their report entitled: *Trash on America's Beaches: A National Assessment.*

Oregon and Connecticut, both of which have bottle bills, requiring a refundable deposit, reported the lowest amount of bottle wastes.

The Entanglement Network is a consortium of 31 environmental, conservation, and animal protection groups. Many other local, state, and national not–for–profit groups have joined the battle to clean up the oceans and Great Lakes. Among them are the American Littoral Society, the Clean Ocean

"Scientists have been concerned and written about the effects of plastic debris on marine mammal populations for over 15 years. But it took the major episodes of debris washing onto popular beaches to raise the general public's ire. Now over 30,000 people across the nation turn out to clean up the beaches."— William E. Evans, former NOAA Administrator.

Kate Wynne

Action and the Marine Debris Roundtable.

As important as these groups are it is the individual that can make a difference. The time to start is now. Here is how you can contribute:

The Individual

● Keep your plastic wastes aboard ship until you get to port and dispose of them properly when you get there. Coast Guard regulations require large ports and marinas to provide adequate reception facilities. Report those that don't have offloading facilities to local Coast Guard officials.

More than 47,500 volunteers paticipated in beach clean–ups in 1988 in 25 U.S. states and territories.

● When you visit the beach or go boating, make sure you dispose of your garbage properly.

● Join the thousands of volunteers throughout the country who participate each year in beach cleanups. Call your state department of natural resources. In ocean and Great Lakes coastal states, contact a university–based Sea Grant program.

● Recycle your nondegradable garbage. Contact officials in your area to find out about local recycling programs and how you can participate.

Support government and private sector programs that work toward reducing persistent marine debris.

● Keep yourself and others informed on new programs, legislation, and actions focused on reducing persistent marine debris by participating in local programs.

● Support government and private sector programs that work toward reducing persistent marine debris. Let your elected officials know how you feel.

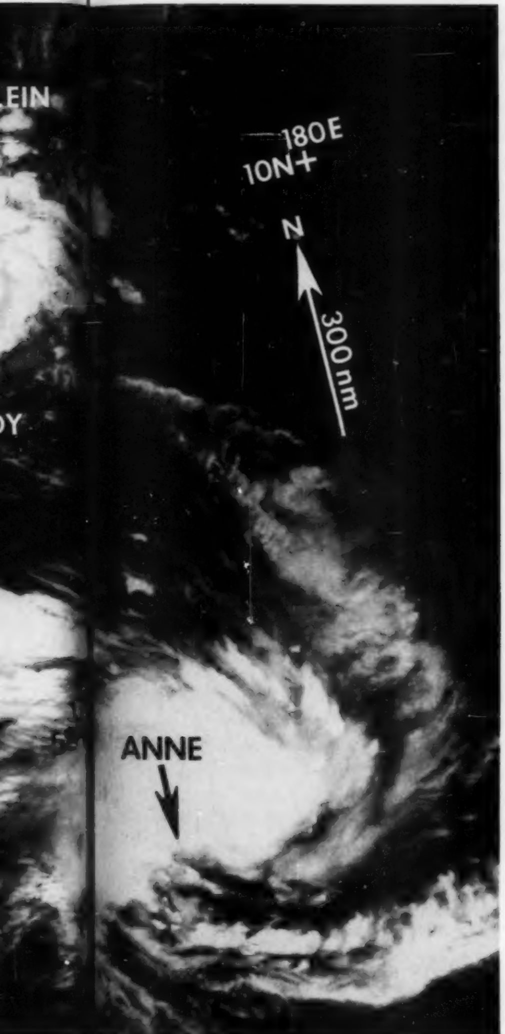
For more information on the marine plastic debris problem and a large color poster of this issue's cover please contact:

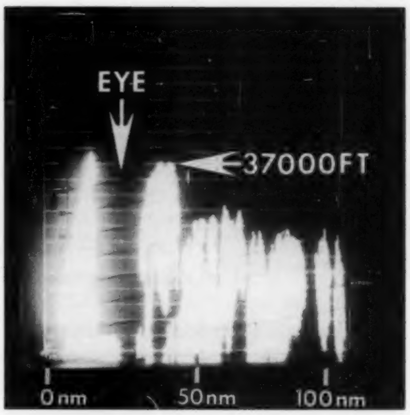
Center for Marine Conservation
1725 DeSales Street, NW
Suite 500
Washington, DC 20036
(202) 429–5609

The Western North Pacific's
Typhoons '88

excerpts from a report by
The Joint Typhoon Warning Center
Guam, Mariana Is.

A rare, destructive January typhoon, a single super typhoon and several short-lived tropical cyclones highlighted a below average typhoon season in the western North Pacific. However the death toll was more than 600. Ruby (above) was mainly responsible for at least 300 deaths, including the capsizing of the **Dona Marylin** *in the Philippines, which resulted in the loss of 150 lives alone.*





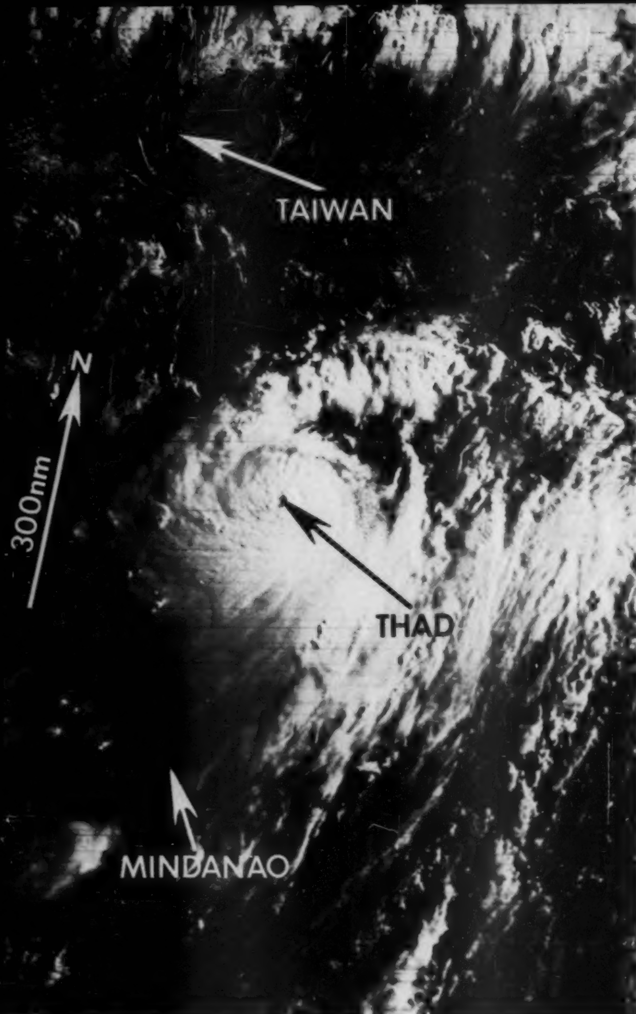
Above and below the equator are Typhoon Roy and Tropical Cyclone Anne on the 8th of January at 1957 UTC. Roy's winds, which gusted to 98 knots, rearranged some cars on Guam (above). Crop damage on Guam was estimated at $23.5 million. Roy's eye is visible on Guam's Andersen AFB radar. The vertical view (left) shows rain echoes reaching 37,000 feet at 0838 UTC on the 11th of January. The radar photograph was furnished by M Sgt Robert W. Yates and Detachment 2, 20th Weather Squadron.

If you call 27 tropical cyclones a below average season then 1988 was that. With 12 typhoons, 13 tropical storms, 1 tropical depression and an invader from the central North Pacific the season was almost four storms below average.

The normal lifespan of a tropical cyclone in the western North Pacific usually exceeds 4 warning days. This year the Joint Typhoon Warning Center (JTWC) encountered a large number of tropical cyclones (13) that were in warning status for 4 days or less.

Typhoon Roy was only the second typhoon in the past 12 years to develop in the western North Pacific during January. The typhoon's near miss of Guam resulted in the most destruction since Super Typhoon Pamela (1976) struck the island. After Roy there was a long break in activity until the end of May. The synoptic pattern during the last week of May was anomalous, with low–level southwesterlies extending across the northern Philippine Sea into the northern Marianas and southern Bonin Islands. Surface pressures in the monsoon trough were 4 to 5 mb below normal. Cyclonic vortices in the trough were transitory until **Typhoon Susan** formed off the coast of Luzon.

As Susan moved northeastward, **Tropical Depression 03W** developed in the enhanced low–level southwesterly monsoonal flow left behind Susan. Then Tropical Depression 03W moved into a subsidence area over China and dissipated. A two week hiatus in tropical cyclone activity followed. Then **Typhoon Thad** formed in the eastern Carolines. It tracked over 2000 nautical miles during its lifetime, recurving just east of the island



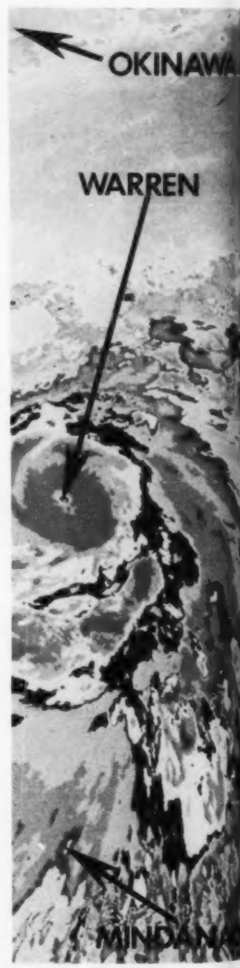
Thad intensifies as it approaches Luzon on the 21st of June at 2128 UTC. It reached a peak of 70 knots early the next day but recurved sparing Luzon and Taiwan. Both Kadena AB and Naha Airport reported winds below 30 knots as Thad passed.

of Luzon and passing 80 nautical miles southeast of Okinawa. With Thad weakening over water to the north, **Tropical Storm Vanessa** developed, to the south, in the Philippine Sea. It was the first *straight–runner* of the year. Vanessa tracked across the Philippine Islands and into the South China Sea before dissipating over southern China.

Almost two weeks passed after Vanessa's demise before **Typhoon Warren** developed in the eastern Caroline Islands. Warren was the second tropical cyclone of the year to threaten Guam. Warren was also the second *straight–runner* of the year and maintained a west–northwestward track during almost its entire lifetime. The system skirted northern Luzon prior to making landfall in southeastern China. **Tropical Storm Agnes** followed a week later and was the last of only two tropical cyclones to develop in July, a month that normally averages five systems. Agnes formed in the area of lower pressures southeast of Japan where the monsoon trough merged with a mid–latitude low pressure system to the northeast. Agnes followed the path of least resistance and accelerated north northeastward along the trough axis.

Once Agnes turned extratropical, the monsoon trough underwent a major readjustment. It then stretched eastward from the Gulf of Tonkin, across the South China Sea, through the Luzon Strait and abruptly terminated near Okinawa. **Tropical Storm Bill** consolidated rapidly at the eastern end of the monsoon trough, brushed by the island of Okinawa and reached a peak intensity of 45 knots before making landfall near Shanghai, China. Bill remained well organized even after making landfall, and caused widespread destruction and loss of life in China. The other four tropical cyclones that developed in August all formed north of 20°N. **Tropical Storm Clara** began in the easterly trade wind north of Wake Island. Clara initially tracked westward, then abruptly changed direction toward the north. Throughout its short lifespan, the system was consistently hindered by vertical wind shear and only peaked at an intensity of 45 knots. **Typhoon Doyle** also fell into the track category of *other* due to its erratic behavior. Initially, Doyle moved rapidly toward the south southwest and looped before tracking northeastward. Once Doyle was extratropical, **Tropical Storm Elsie** and **Typhoon Fabian** formed from persistent convection in the monsoon trough. Both displayed erratic movement during their early stages and underwent binary interaction before turning extratropical.

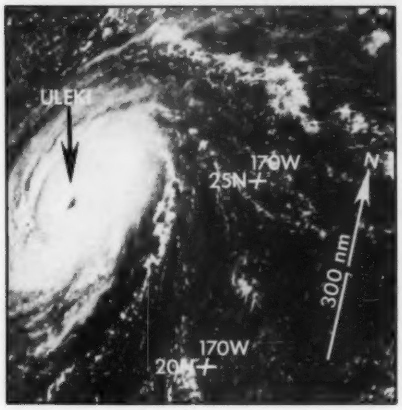
With Elsie and Fabian becoming extratropical, **Tropical Storm Gay,** spawned 420 nautical miles east of Okinawa, attained a peak intensity of



Typhoon Warren at peak intensity of 115 knots at 2247 UTC on the 16th of July. From the 14th to the 16th Warren's winds doubled in speed and its forward speed doubled as well to 15 knots. Warren weakened as it skirted the northern coast of Luzon but caused $10 million crop damage. In China it was responsible for 17 deaths and destroying 13,000 homes.

45 knots. It took the path of least resistance and tracked to the northeast, but was short-lived. As Gay dissipated east of Japan and Uleki churned across the central Pacific, **Typhoon Hal** formed just west of Wake Island. Hal combined with **Typhoon Uleki, Tropical Storm Irma,** and later with **Tropical Storm Jeff** to create two separate three-storm situations. In the meantime, Typhoon Uleki became the third hurricane in the past 30 years to form in the central North Pacific and cross the International Dateline while in a warning status. Tropical Storms Irma and Jeff developed in Hal's strong low-level southwesterly inflow. As Hal, with a large ragged eye, tracked northward, Irma and Jeff followed and were sheared away. Once Hal turned extratropical east of Japan, **Tropical Storm Kit** was a *straight-runner* and tracked over the northern tip of Luzon. It made landfall over southern China, causing loss of life and property damage. While Kit was moving into Luzon, **Tropical Storm Lee** was developing, slowly. Lee tracked over 1,300 nautical miles during a 4-day period as an area of convection before the first warning was issued. It then moved northwestward before recurving and tracking 45 nautical miles southeast of Okinawa. **Tropical Storm Mamie** formed in tandem with Kit and was the second significant tropical cyclone to develop in the South China Sea. After a prolonged southwestward movement, Mamie made a sharp turn and moved northward toward Hong Kong.

After Lee and Mamie, there was a 5-day break before **Super Typhoon Nelson**— the only super typhoon of 1988. The tropical cyclone initially moved westward toward the Philippines then west nortwestward along the southwestern side of the subtropical ridge. Nelson rapidly deepened for 2 days and reached super typhoon intensity shortly before recurvature. It threatened Okinawa. Later, as the system became extratropical and accelerated toward the northeast, it also threatened Japan. While Nelson was weakening and accelerating, **Typhoon Odessa** began some 600 nautical miles



Typhoon Ruby's high winds caused widespread damage in the Philippines. Subic Bay Naval Base and Clark Air Base received their worst damage after the typhoon passed (left). Photo courtesy of the Naval Oceanography Command Facility, Cubi Point, Republic of the Philippines. Hurricane Uleki (below) heads toward the International Dateline at 1846 UTC on the 7th of September. The low sun angle highlights the eye-wall.

south southeast of Japan. During its first 2 days, Odessa moved west northwestward at a speed of 18 knots. It began a gradual recurvature toward the cooler, drier polar air mass from the Asian continent. Odessa intensified into a midget typhoon, peaking at an intensity of 90 knots. At the same time **Tropical Storm Pat** formed equatorward of 10°N. The system tracked westward and attained a peak intensity of 75 knots prior to making landfall over central Luzon. Pat then moved across the Philippine Islands and became the third system to affect Vietnam in 1988. The system reached a peak intensity of 125 knots shortly before making landfall in the Philippines resulting in at least 300 people killed and over 470,000 left homeless.

Ruby (23W) passed 65 nautical miles north northeast of Manila, causing the strongest winds at Clark Air Base since 1978. Ruby then tracked into the South China Sea. Later, flash flooding from the dissipating system's torrential rainshowers resulted in over 100 deaths and widespread destruction of crops in Vietnam.

In November the northeast monsoon became well established across the South China Sea and southeastern Asia. Easterly tradewinds dominated the Philippine Sea north of the near-equatorial trough. After a 1-week respite, **Typhoon Skip** appeared. It was a *straight-runner* and covered over 2,000 nautical miles during its 9-day lifetime. Skip tracked through the Philippines and into the South China Sea. It caused widespread damage to crops in the Philippines and killed over 100 people. **Typhoon Tess** formed in the near-equatorial trough before Skip, but was slow to intensify. It was the only tropical cyclone to track across southern Vietnam this year. After Skip and Tess, a break in tropical cyclone activity occurred until the third week of December. Following a massive outbreak of polar air from Asia, the southern Philippine Sea filled with convection and a near-equatorial trough formed. **Tropical Storm Val**, developed in the trough and peaked at an intensity of 55 knots. Finally, the low-level circulation separated from the deep convection and was carried to the southwest along the edge of the winter monsoon.

Western North Pacific Statistics

Tropical Cyclone Distribution

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
1959	0	1	1	1	0	1	3	8	9	3	2	2	31
	000	010	010	100	000	001	111	512	423	210	200	200	17 7 7
1960	1	0	1	1	1	3	3	9	5	4	1	1	30
	001	000	001	100	010	210	210	810	041	400	100	100	19 8 3
1961	1	1	1	1	4	6	5	7	6	7	2	1	42
	010	010	100	010	211	114	320	313	510	322	101	100	20 11 11
1962	0	1	0	1	3	0	8	8	7	5	4	2	39
	000	010	000	100	201	000	512	701	313	311	301	020	24 6 9
1963	0	0	1	1	0	4	5	4	4	6	0	3	28
	000	000	001	100	000	310	311	301	220	510	000	210	19 6 3
1964	0	0	0	0	3	2	8	8	8	7	6	2	44
	000	000	000	000	201	200	611	350	521	331	420	101	26 13 5
1965	2	2	1	1	2	4	6	7	9	3	2	1	40
	110	020	010	100	101	310	411	322	531	201	110	010	21 13 6
1966	0	0	0	1	2	1	4	9	10	4	5	2	38
	000	000	000	100	200	100	310	531	532	112	122	101	20 10 8
1967	1	0	2	1	1	1	8	10	8	4	4	1	41
	010	000	110	100	010	100	332	343	530	211	400	010	20 15 6
1968	0	1	0	1	0	4	3	8	4	6	4	0	31
	000	001	000	100	000	202	120	341	400	510	400	000	20 7 4
1969	1	0	1	1	0	0	3	3	6	5	2	1	23
	100	000	010	100	000	000	210	210	204	410	110	010	13 6 4
1970	0	1	0	0	0	2	3	7	4	6	4	0	27
	000	100	000	000	000	110	021	421	220	321	130	000	12 12 3
1971	1	0	1	2	5	2	8	5	7	4	2	0	37
	010	000	010	200	230	200	620	311	511	310	110	000	24 11 2
1972	1	0	1	0	0	4	5	5	6	5	2	3	32
	100	000	001	000	000	220	410	320	411	410	200	210	22 8 2
1973	0	0	0	0	0	0	7	6	3	4	3	0	23
	000	000	000	000	000	000	430	231	201	400	030	000	12 9 2
1974	1	0	1	1	1	4	5	7	5	4	4	2	35
	010	000	010	010	100	121	230	232	320	400	220	020	15 17 3
1975	1	0	0	1	0	0	1	6	5	6	3	2	25
	100	000	000	001	000	000	010	411	410	321	210	002	14 6 5
1976	1	1	0	2	2	2	4	4	5	0	2	2	25
	100	010	000	110	200	200	220	130	410	000	110	020	14 11 0
1977	0	0	1	0	1	1	4	2	5	4	2	1	21
	000	000	010	000	001	010	301	020	230	310	200	100	11 8 2
1978	1	0	0	1	0	3	4	8	4	7	4	0	32
	010	000	000	100	000	030	310	341	310	412	121	000	15 13 4
1979	1	0	1	1	2	0	5	4	6	3	2	3	28
	100	000	100	100	011	000	221	202	330	210	110	111	14 9 5
1980	0	0	1	1	4	1	5	3	7	4	1	1	28
	000	000	001	010	220	010	311	201	511	220	100	010	15 9 4
1981	0	0	1	1	1	2	5	8	4	2	3	2	29
	000	000	100	010	010	200	230	251	400	110	210	200	16 12 1
1982	0	0	3	0	1	3	4	5	6	4	1	1	28
	000	000	210	000	100	120	220	500	321	301	100	100	19 7 2
1983	0	0	0	0	0	1	3	6	3	5	5	2	25
	000	000	000	000	000	010	300	231	111	320	320	020	12 11 2
1984	0	0	0	0	0	2	5	7	4	8	3	1	30
	000	000	000	000	000	020	410	232	130	521	300	100	16 11 3
1985	2	0	0	0	1	3	1	7	5	5	1	2	27
	020	000	000	000	100	201	100	520	320	410	010	110	17 9 1
1986	0	1	0	1	2	2	2	5	2	5	4	3	27
	000	100	000	100	110	110	200	410	200	320	220	210	19 8 0
1987	1	0	0	1	0	2	4	4	7	2	3	1	25
	100	000	000	010	000	110	400	310	511	200	120	100	18 6 1
1988	1	0	0	0	1	3	2	5	8	4	2	1	27
	100	000	000	000	100	111	110	230	260	400	200	010	14 12 1
(1959-1988) AVG	0.6	0.3	0.6	0.7	1.2	2.1	4.5	6.2	5.7	4.5	2.8	1.4	30.6
CASES	17	9	18	22	37	63	134	185	172	136	83	43	919

Legend: Total for the month → 6
Typhoons → 3
Tropical Storms → 1
Tropical Depressions → 2

The criteria used in the table above are as follows:

1. If a tropical cyclone was first warned on during the last 2 days of a particular month and continued into the next month for longer than 2 days, then that system was attributed to the second month.
2. If a tropical cyclone was warned on prior to the last 2 days of a month, it was attributed to the prior month, regardless of how long the system lasted.
3. If a tropical cyclone began on the last day of the month and ended on the first day of the next month, that system was attributed to the first month. However, if a tropical cyclone began on the last day of the month and continued into the next month for only 2 days, then it was attributed to the second month.

1988 Significant Tropical Cyclones

TROPICAL CYCLONE		PERIOD OF WARNING	NUMBER OF WARNINGS ISSUED	MAXIMUM SURFACE WINDS KT (M/SEC)	ESTIMATED MSLP - MB
(01W)	TY ROY	08 JAN - 18 JAN	41	115 (59)	927
(02W)	TY SUSAN	30 MAY - 03 JUN	17	80 (41)	963
(03W)	TD 03W	04 JUN - 05 JUN	6	30 (15)	1000
(04W)	TY THAD	20 JUN - 25 JUN	21	70 (36)	972
(05W)	TS VANESSA	26 JUN - 29 JUN	12	45 (23)	991
(06W)	TY WARREN	12 JUL - 20 JUL	30	115 (59)	927
(07W)	TS AGNES	29 JUL - 30 JUL	8	40 (21)	994
(08W)	TS BILL	07 AUG - 08 AUG	5	45 (23)	991
(09W)	TS CLARA	10 AUG - 12 AUG	6	45 (23)	991
(10W)	TY DOYLE	15 AUG - 21 AUG	24	115 (59)	927
(11W)	TS ELSIE	28 AUG - 29 AUG	6	35 (18)	997
(11W)	TS ELSIE*	31 AUG	4	45 (23)	991
(12W)	TY FABIAN	30 AUG - 03 SEP	18	75 (39)	968
(13W)	TS GAY	02 SEP - 04 SEP	6	45 (23)	991
(14W)	TY HAL	08 SEP - 17 SEP	37	105 (54)	938
(01C)	TY ULEKI	08 SEP - 13 SEP	21	90 (46)	954
(15W)	TS IRMA	12 SEP - 15 SEP	16	55 (28)	984
(16W)	TS JEFF	14 SEP - 16 SEP	9	45 (23)	991
(17W)	TS KIT	19 SEP - 22 SEP	12	55 (28)	984
(18W)	TS LEE	21 SEP - 24 SEP	15	55 (28)	984
(19W)	TS MAMIE	22 SEP - 23 SEP	4	45 (23)	991
(20W)	STY NELSON	01 OCT - 08 OCT	30	140 (72)	898
(21W)	TY ODESSA	11 OCT - 16 OCT	22	90 (46)	954
(22W)	TY PAT	18 OCT - 22 OCT	17	75 (39)	968
(23W)	TY RUBY	21 OCT - 28 OCT	30	125 (64)	916
(24W)	TY SKIP	03 NOV - 11 NOV	30	125 (64)	916
(25W)	TY TESS	04 NOV - 06 NOV	10	65 (33)	976
(26W)	TS VAL	22 DEC - 26 DEC	14	55 (28)	984
		TOTAL	471		

* REGENERATED

Tropical Cyclone Summary

TYPHOONS

(1945 - 1958)

	JAN	FEL	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
AVG	0.4	0.1	0.3	0.4	0.7	1.1	2.0	2.9	3.2	2.4	2.0	0.9	16.3
CASES	5	1	4	5	10	15	28	41	45	34	28	12	228

(1959 - 1988)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
AVG	0.3	0.1	0.2	0.5	0.7	1.0	2.7	3.2	3.3	3.0	1.7	0.7	17.4
CASES	8	2	6	15	20	31	81	96	98	91	50	20	518

TROPICAL STORMS AND TYPHOONS

(1945 - 1958)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
AVG	0.4	0.1	0.4	0.5	0.8	1.6	3.0	3.9	4.1	3.3	2.8	1.1	22.0
CASES	6	1	6	7	11	22	42	54	58	46	39	16	308

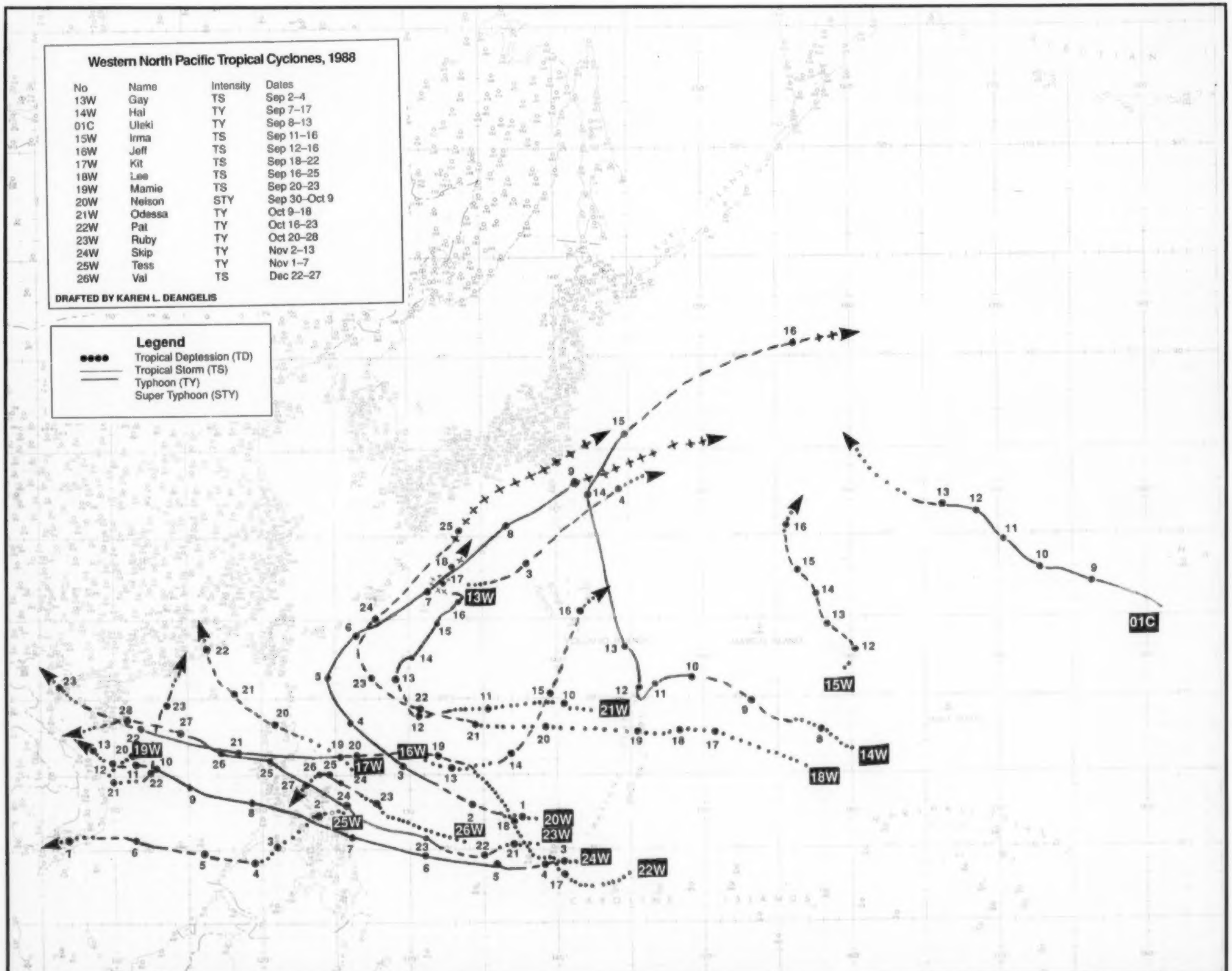
(1959 - 1988)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS
AVG	0.5	0.3	0.5	0.7	1.0	1.8	4.1	5.3	5.0	4.1	2.6	1.3	27.2
CASES	16	9	14	21	31	53	122	160	150	122	78	38	814

FORMATION ALERTS: 26 OF 33 INITIAL FORMATION ALERTS DEVELOPED INTO SIGNIFICANT TROPICAL CYCLONES (NOT INCLUDING ONE ON A SYSTEM THAT REGENERATED). TROPICAL CYCLONE FORMATION ALERTS WERE ISSUED FOR ALL OF THE SIGNIFICANT TROPICAL CYCLONES THAT DEVELOPED IN 1988.

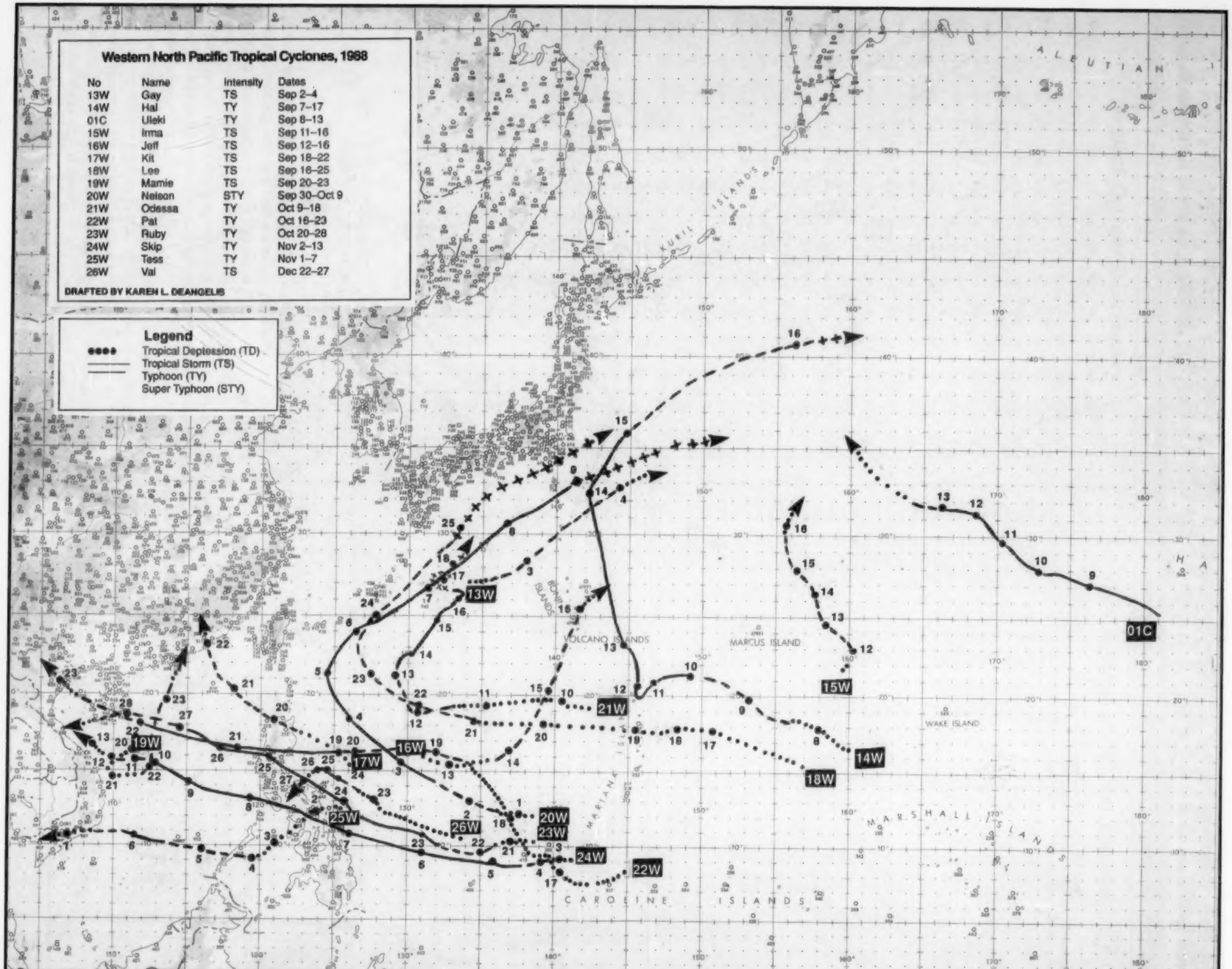
WARNINGS:

NUMBER OF CALENDAR WARNING DAYS: 114
NUMBER OF CALENDAR WARNING DAYS WITH TWO TROPICAL CYCLONES: 15
NUMBER OF CALENDAR WARNING DAYS WITH THREE TROPICAL CYCLONES: 4


Western North Pacific Tropical Cyclones, 1988

No	Name	Intensity	Dates
13W	Gay	TS	Sep 2–4
14W	Hal	TY	Sep 7–17
01C	Uleki	TY	Sep 8–13
15W	Irma	TS	Sep 11–16
16W	Jeff	TS	Sep 12–16
17W	Kit	TS	Sep 18–22
18W	Lee	TS	Sep 16–25
19W	Mamie	TS	Sep 20–23
20W	Nelson	STY	Sep 30–Oct 9
21W	Odessa	TY	Oct 9–18
22W	Pat	TY	Oct 16–23
23W	Ruby	TY	Oct 20–28
24W	Skip	TY	Nov 2–13
25W	Tess	TY	Nov 1–7
26W	Val	TS	Dec 22–27

DRAFTED BY KAREN L. DEANGELIS
Legend
Tropical Depression (TD)
Tropical Storm (TS)
Typhoon (TY)
Super Typhoon (STY)
CAROLINE ISLANDS



Western North Pacific Tropical Cyclones, 1988

No	Name	Intensity	Dates
13W	Gay	TS	Sep 2–4
14W	Hal	TY	Sep 7–17
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15W	Irma	TS	Sep 11–16
16W	Jeff	TS	Sep 12–16
17W	Kit	TS	Sep 18–22
18W	Lee	TS	Sep 16–25
19W	Mamie	TS	Sep 20–23
20W	Nelson	STY	Sep 30–Oct 9
21W	Odessa	TY	Oct 9–18
22W	Pat	TY	Oct 16–23
23W	Ruby	TY	Oct 20–28
24W	Skip	TY	Nov 2–13
25W	Tess	TY	Nov 1–7
26W	Val	TS	Dec 22–27

DRAFTED BY KAREN L. DEANGELIS

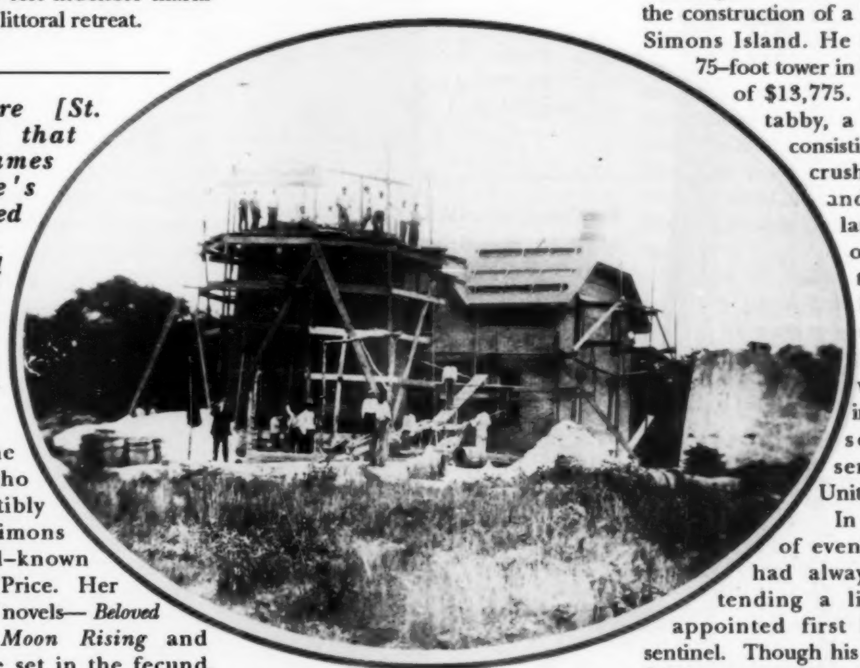
St. Simons Lighthouse

Elinor DeWire
Mystic Seaport Museum
Mystic, CT 06355

Seventy-five miles south of the entrance to the Savannah River is lively St. Simons Island, named for a Spanish mission established there in the 1500s to christianize the Cherokee and Creek Indians. About the size of Manhattan Island and typical of the hot, humid necklace of isles clutching Georgia's Atlantic throat, St. Simons has witnessed more than its share of boredom and excitement.

It's a tranquil retreat for vacationers and a popular day-trip destination, but also the permanent home of a small community of loyal Georgia residents. Lured to its balmy, subtropical shores for a variety of reasons, visitor and native alike have left indelible marks on this charming littoral retreat.

It was here [St. Simons Is.] that General James Oglethorpe's troops defeated the Spanish in 1742 and secured coastal Georgia for England.



This new St. Simons Lighthouse, replacing the one destroyed in the Civil War, was under construction in 1871 and was completed on September 1, 1872.

Among the personalities who were irresistibly drawn to St. Simons Island was well-known author Eugenia Price. Her famous trilogy of novels— *Beloved Invader, New Moon Rising* and *Lighthouse*— are set in the fecund, mosquito-thick marshland at St. Simons Island. The latter book is still popular with island residents, since it was no doubt inspired by the handsome, 104-foot St. Simons Lighthouse.

Long before the lighthouse was built, a fort stood on St. Simons Island. It was here that General James Oglethorpe's troops defeated the Spanish in 1742 and secured coastal Georgia for England. Oglethorpe's colony at Savannah had been settled only 9 years before, and a lighthouse had been built at Tybee Island in 1741. The fledgling colony realized the importance of erecting additional navigational aids for the rum and slave trade, but it wasn't until after the Revolution that funds became available for this purpose.

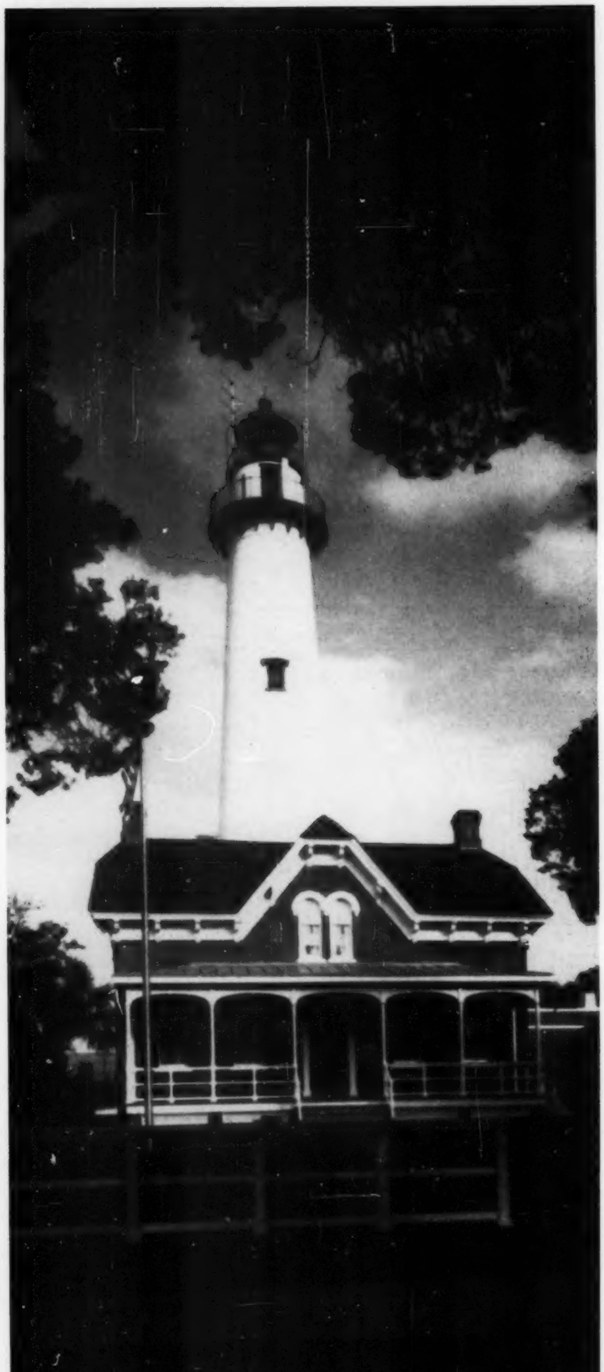
As with most southern lighthouses St. Simons Light was irreparably damaged during the Civil War by dynamite and fire.

In 1807 a Massachusetts contractor named James Gould won the bid for the construction of a lighthouse at St. Simons Island. He completed the 75-foot tower in 3 years for a cost of $13,775. It was built of tabby, a local material consisting of lime, sand, crushed oyster shell, and water. Oil lamps suspended on chains from the ceiling of the lantern room served as the beacon. When it was illuminated in 1810, it was the southernmost sentinel in the United States.

In a fortunate turn of events, Gould, who had always dreamed of tending a lighthouse, was appointed first keeper of the sentinel. Though his pay was a paltry $400 per year, he remained almost three decades and was commended by the Lighthouse Service for his fastidious and diligent work.

As with most southern lighthouses, St. Simons Light was irreparably damaged during the Civil War by dynamite and fire. No beacon shone from the site again until 1872 when a new, taller lighthouse replaced the

FRONT ELEVATION



Then and Now— The sketch of St. Simons Light was taken from a Plan of Third Order Light House drawn in 1867 under the direction of Brevet Brigadier General O. M. Poe. At right is a recent photograph taken by the author.

Carl Olaf Svendsen (above), along with his wife, tended St. Simons Light from just after the turn of the century until 1935.

original one. Built by Georgia architect Charles Cluskey, it rose 104 feet, sported a new, third-order Fresnel lens, and adjoined a beautiful Victorian keepers' house. Of Savannah gray brick, it ran over three times the cost of its predecessor.

The new tower and residence seemed an idyllic assignment, but problems with putrid water and hoards of relentless mosquitoes made it one of the South's most unhealthful light stations. Even architect Cluskey had not lived to see the lighthouse placed in service. He had succumbed to yellow fever in 1871.

The ghost was thought to be the restless spirit of an assistant keeper who was murdered at the station...

The Lighthouse Board wisely appropriated money to drain the stagnant ponds in the vicinity of the lighthouse in hopes of reducing the mosquito population and improving the station's water supply.

Shortly after the turn of the century, one of St. Simons' most memorable families arrived at the lighthouse. Carl Ola Svendsen and his wife would steadfastly remain on duty until 1935. Many storms and exciting events marked their tenure, but they are best remembered for their lighthearted accounts of the noisy, mischievous ghost who shared their lighthouse home and seemed to derive great enjoyment from terrorizing their dog.

The ghost was thought to be the restless spirit of an assistant keeper who was murdered at the station a few years before the Svendsens arrived. Jinx, the family dog, was the first to encounter the ghost and the only one never to befriend it.

The door eased open and swallowed the flickering light of the kitchen lamp into its dark recess.

One evening, as Mrs. Svendsen was preparing supper, footsteps were heard clanking down the iron lighthouse stairs. Mrs. Svendsen assumed they belonged to her husband who had gone up into the tower to light the beacon. An oil lamp burned in the twilight kitchen, and as the footsteps neared the door, Jinx lifted his head slowly and let out a low growl.

The door eased open and swallowed the flickering light of the kitchen lamp into its dark recess. No sound came from the empty doorway; no figure advanced out of the darkness. The fur on Jinxs' neck bristled, and he backed away with measured steps.

Mrs. Svendsen walked to the door, stepped through, and called out to her husband. There was no answer, but she felt a damp, coldness around her. Alarmed, she raced to the top of the lighthouse to find her husband still at work, where he claimed to have been for hours.

Sentinels of the Sea ***... traces the history and lore of lighthouses all across America.***

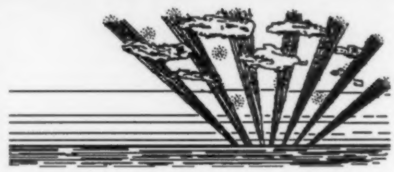
The ghost would clamorously appear many more times before the Svendsens retired from St. Simons Lighthouse. After a few months, its visits ceased to startle the family and almost became a welcome diversion to their monotonous duties. Jinx, on the other hand, never befriended the spirit. As years passed, and Jinx grew old and tired, it almost seemed as if the ghost's sole delight was to harass him.

Today, St. Simons Lighthouse runs automatically and is accessible to the public as part of the Museum of Coastal History. A portion of the keepers' house has been restored with Victorian Era furnishings. There are also displays of local history, and **Sentinels of the Sea**, an exhibit commemorating the Bicentennial of the old Lighthouse Service, traces the history and lore of lighthouses all across America.

Of course, the expected seaside delights are also part of the lighthouse landscape—the wonderful shore with its birds, shells, whispering combers, and enduring sands.

For information on museum hours and displays contact:

Museum of Coastal History
Box 1151,
St. Simons Island,
GA 31522.



Phosphorescent Displays—3

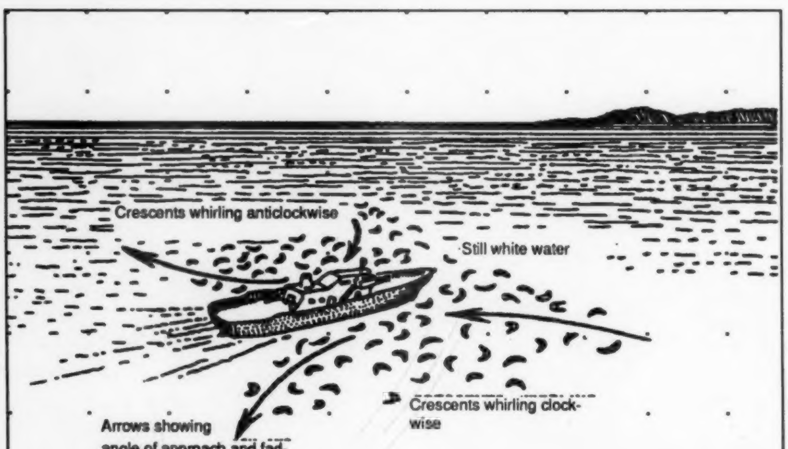
William R. Corliss
P.O. Box 107
Glen Arm, MD 21057

In the previous two columns we have looked at phosphorescent displays in the shapes of wheels and bands. They have also been seen as expanding rings, patches moving in circles, spinning crescents, underwater lightning and a milky sea.

Expanding phosphorescent rings

Expanding phosphorescent rings are rare, usually seen as white or green ripples of phosphorescence expanding from a central point at high speeds. Several centers may be active at the same time. Ripples are circular or elliptical. The following report appeared in the Marine Observer.

October 14, 1970, Gulf of Oman. "At 2130 GMT three very fast outward–moving rings of light were seen emanating suddenly from three separate vortices which were spaced about 3 cables apart in a straight line parallel to the ship's fore and aft line, and about 5 cables distant ton the starboard side: the positions of the vortices in the water appeared to remain unchanged. The first two appeared almost simultaneously and produced circular rings, at a frequency of about 1 second or slightly less. The third appeared a minute or so later and produced elliptical rings which were moving much faster than the others. They appeared about 2 points forward of the starboard beam and disappeared about 4 points abaft the beam. Their disappearance was more or less simultaneous. Although the individual patterns tended to cut across and overlap each other at places, they did not become confused, nor were they stopped by the ship's hull, as the rings could be clearly seen to pass from starboard to port when in line with the bridge. There was bright moonlight, and it was therefore fairly certain that there was no disturbance on the surface at any time, such as might be caused by jumping fish, etc."



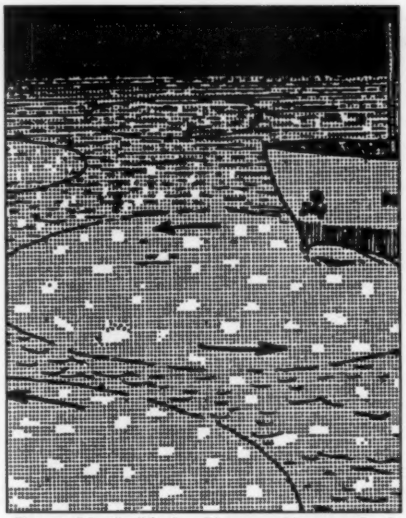
This display of rotating phosphorescent crescents was apparently radar initiated. This is what it looked like in the Gulf of Oman on November 30, 1951. The crescents conveyed the impression that they ricocheted from each other in meeting at the ship's bows and then turned away astern.

Phosphorescent spinning crescents

Phosphorescent spinning crescents are a bizarre display consisting of rotating crescents of light centered on the ship and sweeping toward the ship or rotating around it. Observed on both sides of the ship, the crescents may reverse their direction of rotation. Ship's radar may influence this phenomenon. This apparently occurred in the Gulf of Oman on November 30, 1951. The ship's radar had been switched on to check her position, when, in the same instant the most brilliant boomerang–shaped areas of phosphorescent light appeared in the sea rotating in a clockwise direction to starboard and counterclockwise to port, all sweeping inward toward the ship from about 2 miles away.

White water

White water or a milky sea is a white phosphorescent display consisting of a soft but often brilliant luminous sea stretching for many miles. The milky sea has often been compared to a field of snow, during which the horizon may seem to disappear much as it does during arctic white–outs. The sea's surface often seems subdued during this eerie spectacle, although the motion of the ship indicates that this is not so. In some instances, the light seems to come from great depths as if from huge underwater searchlights. At other times, there



Reported in the Marine Observer, this example of phosphorscent patches moving in circles occurred on the 30th of May 1956 in the Persian Gulf. After a display of moving parallel bands, the line formation disappeared and patches were seen to be moving fairly slowly in a counterclockwise circle. These circles were 100 to 300 feet in diameter. When the vessel passed through a circle the patches of light would disappear on reaching the port side and reappear on starboard in the same formation.

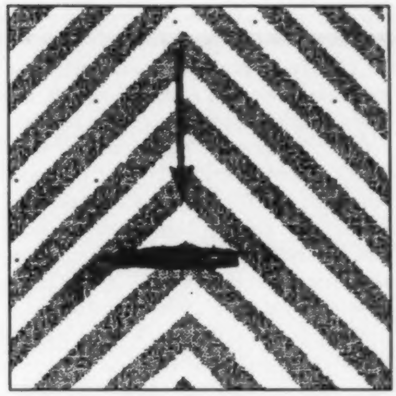
seems to be a luminous fog or mist above the water surface. Milky seas can appear suddenly over a wide region. They may wax and wane over periods of several hours. The geographical distribution of milky seas is much wider than for the phosphorescent wheels, being found in all oceans at any season. Nevertheless, they seem to concentrate in the Arabian Sea during summer months.

A wonderful account of this phenomenon appeared in the American Journal of Science in 1830.

September 7, 1826, Gulf of St. Lawrence: "The night was star lit, but suddenly the sky became overcast in the direction of the high land of Cornwallis county, and a rapid, instantaneous and immensely brilliant light, resembling the Aurora Borealis, shot out of the hitherto gloomy and dark sea on the lee bow, and was so vivid that it lighted every thing distinctly, even to the mast head. The mate, having alarmed the master, put the helm down, took in sail and called all hands up. The light now spread over the whole sea between the two shores; and the waves, which before had been tranquil, now began to be agitated. Capt. B. describes the scene, as that of a blazing sheet of awful and most brilliant light. A long and vivid line of light, superior in brightness to the parts of the sea not immediately near the vessel, showed us the base of the high, frowning and dark land abreast of us; the sky became lowering and intensely obscure. The oldest sailors on board had never seen anything of the kind to compare with it, except the captain, who said that he had observed something of the kind in the Trades. Long tortuous lines of light in a contrary direction to the sea, shewed us immense numbers of very large fish darting about as if in consternation at the scene. The spirit–sail yard and mizenboom were lighted by the reflection as though gas lights had been burning immediately under them; and until just before day break, at four o'clock, the most minute objects in a watch were distinctly visible. Day broke very slowly, and the sun rose of a fiery and threatening aspect. Rain followed."

A more recent but less colorful account appeared in the Marine Observer in 1978.

August 4, 1977, Indian Ocean: "At 1735 the vessel encountered a very large area of milky sea, the area stretched as far as the horizon. The intensity was so great that the deck appeared to be just a black shadow. There was an apparent increase in humidity and a small number of fish together with a small amount of seaweed were observed. During the phenomenon the Radio Officer reported a decrease in signal strength on HF and static on MF frequencies. The intensity of the phenomenon decreased for five minutes at about 1800, thereafter, it increased again and was observed until 1911."



This example of a V–shaped phosphorscent display was also reported in the Marine Observer. It occurred in the Malacca Strait on February 14, 1977. A wheel–type display appeared to the starboard and soon afterward a change in the pattern was observed. The spokes had formed an inverted V–shape with the apex pointing away from the ship. It was rushing toward the ship's starboard side and would reappear on the port side moving away. The pattern then changed twice more in rapid succession; first to a counterclockwise wheel and then to a clockwise wheel, both times with the center to starboard.

Te Lapa

One of the most unusual and rarest displays is known by the Polynesians as Te lapa (underwater lightning). It is composed of streaks of light and flashes appearing well below the surface of the ocean apparently emanating from distant land masses. According to a polynesian sailor the phenomenon is best seen 80 to 100 miles out and disappear by the time an atoll is well in sight. They use it to steer by on overcast nights. It was observed by a writer for National Geographic Magazine.

In response to your request for comments on the GMDSS system, I'd like to offer the following observations.

We have a Marisat on my ship (***M/V Greenlake*** KGTI) and it works fine, but I wouldn't want to stake my life on it. The problem with the new GMDSS system is the over reliance on satellite systems for long distance communications. Without this long distance capability a shore based system wouldn't be possible.

There are several problems with the Marisat System. On ship, there's no backup power system. If you lose power the Marisat goes dead and it's back to morse code. I understand they have DC battery powered systems now (though I wonder if the antenna pointing systems also operate on DC). Assuming that DC powered shipboard terminals become available, there are other problems. The ship terminal must be able to see the satellite. If a ship was so unfortunate as to develop a list away from the satellite the shipboard terminal might not be able to access it.

You might think these problems very unlikely, but both have already occurred. Several years ago a Holland America line passenger ship had a fire in the engine room while on a voyage from Seattle up to Alaska. The Marisat lost power and went dead, then the ship began to list so that even when power was restored, they couldn't access the satellite because the dish couldn't see the satellite because of the angle of the ship. Luckily there was a radio operator onboard and he fell back on his battery powered morse code equipment to get out a distress message.

The other problem with satellite based systems are their vulnerability to accidental or deliberate interference. A malfunctioning terminal on a ship can blank out or degrade a distress message. A two bit terrorist group operating out of some basket case country like Lebanon could hold Marisat and shipping

companies hostage by jamming satellite communications. It's incredibly easy to do, and I'm sure someone will try it sooner or later and disrupt the entire GMDSS system.

I'm no fan of morse code and I'm not anti high tech. But I don't think we should pin all our hopes on satellite technology which makes a shore based system possible. I think we need a remain primarily a ship based system using an automated system such as SITOR/ARQ, with the shore based system as a backup.

Unfortunately the whole GMDSS discussion is contaminated with commercial factors. The satellite system is favored because it allows removal of the radio operator and cost savings for the companies. It may take another Titanic type disaster in the future to undo this risky system. Technology may change, but human nature doesn't. We still place our faith totally in technology to provide the quick fix at sea.

Andrew Bourassa, R.E.O
M/V Green Lake KGTI 1500464

Some good points are made here. Satellites and computers are wonderful inventions but I wouldn't want to stake my life on them alone either.—ed

Ship Weather Reports

All ships weather reports transmitted to shore should include BBXX as the first group in the text.
Example:
BBXX WLXX 29003 99131 70808 41988 60909 10250 20211/ 40110 52003 71611 85264 22234 00261 31100 40803

Hawaii Schedule Change

The radio broadcasts out of Pearl Harbor, HI have been altered significantly. The ammended schedule can be found on page 75.

Julie L. Houston
National Weather Service
Silver Spring, MD 20910

Meteorological Ship Observations

Ships are reminded to use the correct format for Meteorological Surface Observations. Meteorological Observations should begin with the Ship's call sign.

INMARSAT Format Example

WLXX 29003 99131 70808 41998 60909 10250 2021/ 40110 52003 71611 85264 22234 00261 31100 40803 ....

Coastal Radio Station Example

WLXX 2900399131 7080841998 6090910250 2021/40110 5200371611 8526422234 0026120201 3110040803

INMARSAT Reports Procedure

INMARSAT Equipped ships may transmit weather messages using the following procedures after the message is composed off-line:

1. Select U.S. Coast Earth Station Identification CODE 01.
2. Select routine priority.
3. Select duplex telex channel.
4. Initiate the call.

Upon receipt of GA (Go Ahead).

5. Select dial code for meteorological reports, 41, followed by the end of selection signal, +.

41+ (or 00 23 6715250+)

6. Upon receipt of our answerback, NWS OBS MHTS, transmit the ships call sign and the weather message only. Do not send any other preamble.

BATHYTHERMAL/TESAC OBSERVATIONS

Ships are reminded to use the correct format for Bathythermal/Tesac Observations. Bathys/Tesac should start with JJXX and end with the Call Sign.

EXAMPLE: **JJXX** 20106 0312/ 74519 05528 88888 00098 26097 28098 29094 33069 36044 37026 38014 39009 41004 46503 48505 59508 84512 9901 36512 37512 38512 39355 46355 0000 **VCTB**

Selected Worldwide Marine Weather Broadcasts

The 1988 edition of **Selected Worldwide Marine Weather Broadcasts** is available from:

Superintendent of Documents
U.S. Government Printing Office
Washington DC 20402

The cost is $9.00. Please refer to stock no. 003-017-00534-8 when ordering. If your vessel is in the VOS program you can obtain a free copy from your PMO.

Please send any changes to the publication **Selected Worldwide Marine Weather Broadcasts** to the following address:

National Weather Service
International Telecommunications
Section W/0S0151 Room 419
8060 13th Street
Silver Spring, MD 20910

Available

Information concerning Coast Earth Station ID codes and Telex and Telephone Country Codes can be found in the INMARSAT Users Guide. The Users Guide is available at the address below:

COMSAT Maritime Services
950 L'Enfant Plaza, S.W.
Washington, DC 20024
ATTN: James Jansco

Cold Remedies for Cameras

When shooting pictures of winter maritime scenes care must be taken for equipment, film and photographer. Since most mariners are prepared for the cold, that leaves camera and film. Conditions below 0°F are a whole other ballgame so these suggestions are aimed mainly at the temperature range from about freezing to 0°F. In any case the basic principle is the same— keep your equipment warm (which makes sense in more than just photography). The simpler the camera the better is often a good rule of thumb, since there are less things to freeze. Frozen batteries are no good. Most of the good newer cameras are lubricated with synthetic materials that work well to below 0°F. Lenses, especially long and zoom lenses, can be sensitive to the cold. The best advice is to keep your camera inside your coat or cold weather gear, using your body heat to keep it warm. If this isn't feasible at least keep your batteries warm.

Film can become brittle in the cold. Care should be taken when temperatures drop to near 0°F to wind and rewind the film slowly. In very cold conditions it would be advisable to stop shooting two or three frames before the end of the roll so as not to chance a break or tear as the film comes to the end. With automatic cameras it might be smart to rewind the film inside if possible. If conditions are dry as well as cold, static discharges could register on the film—another reason for winding and rewinding slowly. Cold temperatures may cause a color shift as one emulsion layer slows up more than another. Bracketing up to two or three stops on either side of the meter reading, could save a classic shot. In addition some films have a wide exposure latitude, which is useful when the air gets frigid.

Ice and snow can create exposure problems since they are highly reflective. While they may help illuminate a scene, they can fool your meter. If you meter on ice or snow it will read them as medium gray and they will come out looking that way. For an averaging meter on an automatic camera it is advised to set the ASA scale at half the true film speed under these circumstances. For example ASA 64 would be set at 32. If you use a hand held meter the best procedure would be to use a gray card that is made for this purpose. With a spot meter a light shadow area would suffice.

It may seem like a lot of trouble to use a camera in cold weather but some of the most beautiful photographs are winter scenes.

Photos from Mariners

Edward Sinclair, commanding officer of the USCGC ***Biscayne Bay***, has added another to his fine contributions of photographs. This is the red lighthouse in Manistique East Breakwater Light. This lighthouse (below) was recently renovated by the crew of the ***Biscayne Bay***.

The ***M/V Noble Star*** on a voyage from San Francisco to Korea, in the winter of 1989, ran into Force 8 winds (34 to 40 Knots). The skipper T. Buckley got some wonderful photographs (previous page and this page) showing just what the sea looks like in these conditions. While it may not impress a lot of mariners it sure gives us small boat owners a view of the ocean we would not want to experience.

A Note of Thanks

Occasionally, weather forecasters and researchers have a special need to maximize the number of marine observations at certain locations and at certain times. This is often the case near hurricanes or during special research projects.

During February and March, 1989, an experiment called GUFMEX took place in the Gulf of Mexico. Its object was to study the characteristics of continental air as it moves over the Gulf of Mexico, picks up moisture, and returns northward over the southern United States. To supplement extra balloon soundings, research vessels and aircraft observations, a request was sent to all ships in the Gulf of Mexico to take additional observations— and the

response was overwhelming!

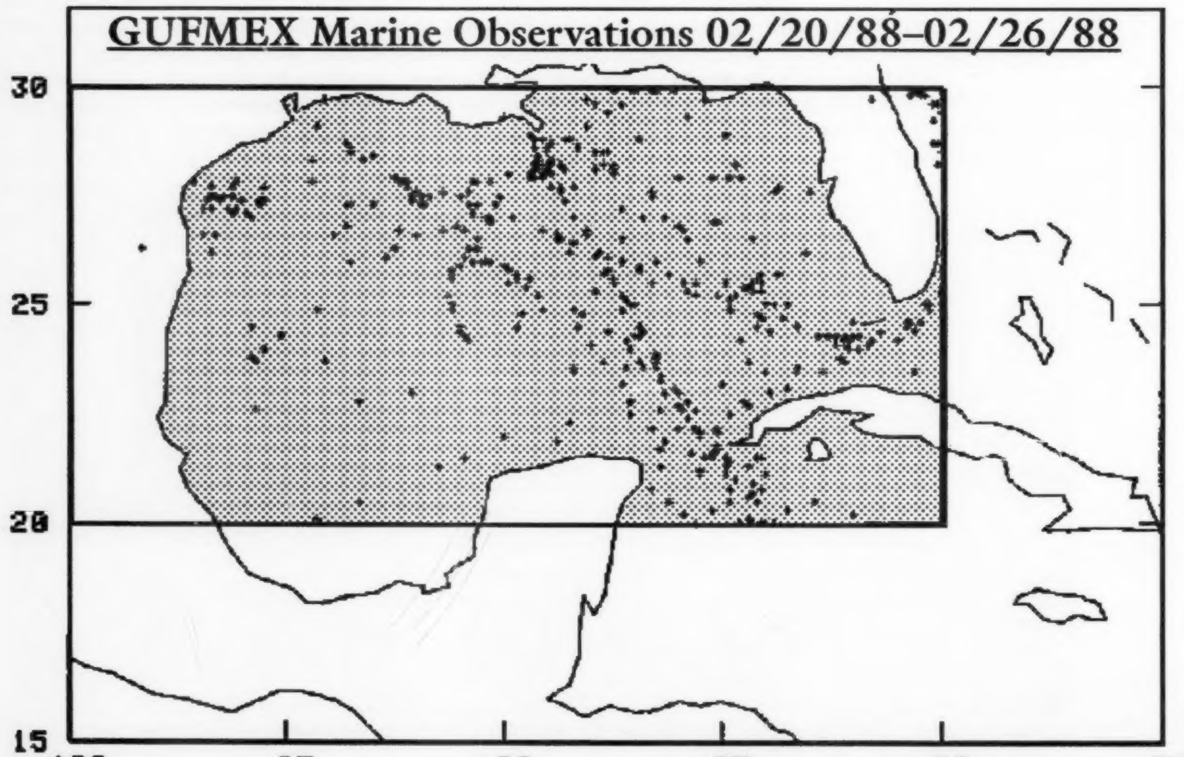
So, a hearty note of thanks on behalf of the GUFMEX researchers and forecasters. You and your observations are appreciated!

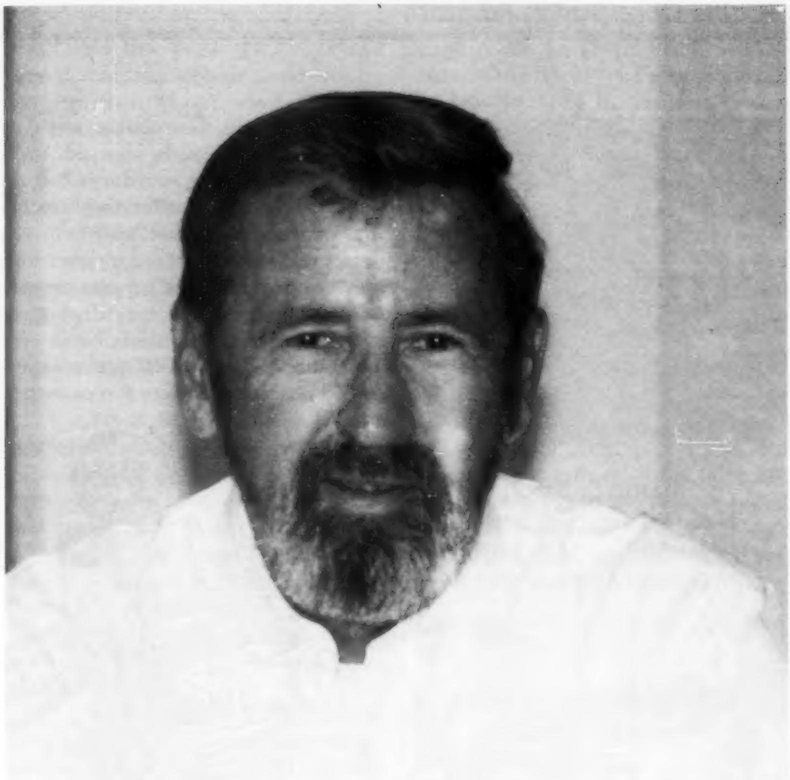
Steve Rinard
NWS, NOAA
Fort Worth, Texas

Calendar Available

We have had a number of requests for more information about the Historical Society of Michigan's Lighthouse Calendar. The 1990 edition is now available and features such lights as Twin Sisters (Lake St. Clair), Wind Point (Lake Michigan), Port Dover (Lake Superior) and Oswego (Lake Ontario). The sketches are by Leo Kuschel and the descriptive passages by Sue Kuschel. The basic cost is $6.95 ($8.35 Canadian) plus $2.00 shipping and handling. Michigan residents add 4% sales tax. They are available from:

Historical Society of Michigan
2117 Washtenaw
Ann Arbor, MI 48104
Tel. No. (313) 769–1828





Getting to Know Your PMO

Pete Connors is the senior Port Meteorological Officer in terms of time served. He works out of Miami, FL. I want to thank him for taking time out from a busy schedule to answer a few questions.

MWL: How long have you been a PMO?

Pete: I have been on this job since September 1978, in Beaumont–Port Arthur, TX.

MWL: What were you doing before taking the PMO job?

Pete: From 1968 through 1978 I sailed on the NOAA ship ***Discoverer*** during the Barbados Oceanographic and Meteorological Experiment (BOMEX). I also sailed on the NOAA ship ***Oceanographer*** during the Global Atlantic Tropical Experiment (GATE).

MWL: Well that was certainly good training for your present position. Did you have any other at sea duty?

Pete: From 1963–1965 I sailed with the Atlantic Weather Patrol, aboard the R/V ***Anton Bruin***. During the International Indian Ocean Experiment, in 1965–66, I sailed on the Antarctic research vessel, ***Eltannin***. Then in 1967 I was aboard the NOAA ship ***Oceanographer*** during its around the world cruise.

MWL: I guess your qualified. Have you seen many changes in the ships and the VOS program since you became a landlubber?

Pete: Since I've been aboard there have been many changes in the VOS program. Perhaps the most dramatic change is in the transmitting of weather observations from ship to the National Meteorological Center in Suitland, MD via the Shipboard Environmental Data Acquisition System (SEAS). This is a great asset for receiving real time data.

MWL: We hear stories about the dangers of being a PMO, in addition, of course, to the social hazards. Are there problems on the docks?

Pete: The hazards most encountered on the docks are taking evasive action from the forklift drivers. Seriously, there are many dangers both on the docks and aboard ships. You have got to be alert to these hazards.

MWL: Is there a problem with mariners feeling that their observations are less important in the satellite era?

Pete: Most ship personnel realize that the satellite does not give all the parameters of a shipboard weather observation.

MWL: In addition to conferences in New Orleans, does you work require much other rugged traveling?

Pete: I travel from Tampa to Key West, usually about once a year.

MWL: For any cute 3/M out there (see page 39) are you still available? (Pete's phone no. is on the inside back cover.)

Pete: I am single and live about 12 miles from my office, which is located at the Port of Miami.

MWL: Pete, do the PMO's make a difference?

Pete: I believe for the VOS program to work you must have personal contact with the ship people. They are voluntarily taking observations and the PMO is their point of contact for this effort.

WMO Requests Prefix BBXX in Weather Message

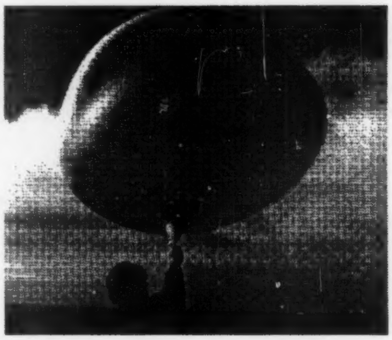
The World Meteorological Organization (WMO), which establishes policy for the coding of weather messages, is asking vessels to include the header **BBXX** immediately preceding the ships' call sign when transmitting weather observations. The symbolic code letters **BBXX** identify the message as a ship's weather report, as explained in the WMO manual on codes (WMO–No. 306), for code form FM 13–IX SHIP.

The **BBXX** header will help identify the reports as ship reports, especially when transmitted over the Global Telecommunications System (GTS), used to relay weather data throughout the world. Accordingly, please send your weather messages using the **BBXX** prefix as follows:

(1) For regular weather reports:
BBXX (standard weather report beginning with ship's call sign).

(2) For storm or special reports:
BBXX STORM or SPREP (standard weather report beginning with ship's call sign) TROPICAL STORM KAY MIN PRES 980 HPA 1750z MAX WIND 63 KNTS GUST 74 KNTS 1745z.

Please remember, the main weather reporting times for ships are 0000, 0600, 1200, and 1800 UTC or ZULU. From coastal waters of the United States and Canada (out 200 miles from shore), report the weather at three hourly intervals if you can — at 0000, 0300, 0600, 0900, etc. The 3–hourly reporting schedule should also be used when you are within 300 miles of a named tropical storm or hurricane (for STORM reports). Special reports (SPREP) can be sent at any time to alert the National Weather Service to significant weather that has not been forecast.



Martin S. Baron
National Weather Service
Silver Spring, MD 20910

The Importance of Being Weather Conscious

Taking weather observations to record changes in air pressure, winds, clouds, visibility, sea, etc. is an essential part of the duties of most deck officers. Aboard sailing ships and small craft, safety, and forward progress are almost entirely contingent upon wind and weather conditions. Even aboard larger power driven ships, the weather plays a very significant role in vessel operations, having a major impact on ship schedules, the security of cargo, planned routes, fuel consumption, human safety and comfort. Being weatherwise is a basic part of good watchkeeping.

To assist ships' officers with their meteorological duties, the Port Meteorological Officer (PMO) spends about 90% of his time visiting ships. Please call on the PMO with any meteorological questions or concerns you may have. The PMO's regular duties include calibrating and maintaining your equipment, inspecting your completed observations for accuracy and completeness, and supplying you with reporting forms, instructions and aids. The PMO will provide you with training about proper procedures for taking, coding, and transmitting weather observations. He can also help you interpret and understand weather forecasts and warnings, and can provide insight concerning meteorological analysis received with your fax machine. All NWS PMO's are experienced observers, and/or forecasters.

Weather Data Acquisition Methods Over the Oceans

Ships remain the most important data source over the oceans. They provide accurate, detailed, coded, surface observations over vast marine areas. The preparation of surface analysis charts for both the northern and southern hemispheres, would not be possible without ships reports. These charts are a necessity to the meteorologist, because they indicate the locations

of the basic weather systems such as high and low pressure areas and fronts, contain isobars (and hence, information about winds). Ship reports to a forecaster can be likened to a carpenters need for a hammer and nails when he constructs the frame of a house.

Satellites are next in importance to ship reports. Satellite cloud photo imagery is very helpful in locating weather systems, particularly tropical storms and hurricanes, and in determining their strength and movement.

Fixed Buoys provide important information in some coastal and offshore areas of the world. They are very expensive to operate, maintain, and deploy.

Drifting Buoys are a supplemental data source, usually providing data on pressure and winds only. Their use is limited because equipment cannot be calibrated after release.

Aircraft are used to investigate tropical storms and hurricanes, and also supply some upper air data from flight levels.

Ocean Weather Stations (OWS) are vessels deployed to take surface and upper air observations in critical locations. In recent years, several European nations have operated OWS, including France, the United Kingdom, Norway, the Soviet Union, and the Netherlands. Japan operates an OWS during the typhoon season only. OWS are very expensive to run, and for this reason, the United States and Canada had to discontinue their joint OWS in the North Pacific (***Papa***).

Mariner Reports (MAREP) are plain language reports usually from areas very close to shore. Since they are not coded, their use is limited to local forecast operations.

Ships provide nearly 100,000 weather observations from coastal, offshore, and high seas areas each month. The cooperation and diligence of ship's officers makes these data relatively inexpensive and highly accurate. The universality of the data code (code FM13–IX SHIP), which means the same code being used worldwide, is of the utmost importance, because it allows for rapid computer processing and international exchange of data. If different codes were used, as was the case before the 20th century, translating and processing data would be a very difficult and time consuming task for the national meteorological centers of the world to perform.

The other six data sources supplement, and are utilized in support of ship data. They are either available from geographically limited areas (reports from buoys, aircraft, OWS, MAREP), do not provide coded data (MAREP), or have very high operations, maintenance, and deployment costs (satellites, buoys, OWS).

John Warrelmann, PMO Newark, NJ

New PMO's In New York and Newark

John Warrelmann, Jr. has been selected to fill the PMO position in Newark, New Jersey, replacing George Klein who is now working at the National Weather Service Forecast Office in New York. John is a native of New Jersey, born and raised in the town of Bound Brook. He spent 24 years in the Marine Corps, where he specialized in weather observing and forecasting. He attended many military schools, where he studied weather observing, forecasting, and the interpretation and theory of radar, satellite and radiosonde data. Since retiring from the military in 1984, he has worked as a data archivist at the Air Force weather records center in Asheville, North Carolina, as a weather briefer and forecaster at Tyndall Air Force Base, Florida, and with the National Weather Service at Key West, FL. John is married and has 2 sons.

Dee Letterman is the new PMO in New York City, replacing Bob Baskerville who retired in September, 1989. Biographical information on Dee will be available in the next issue of the Mariners Weather Log.

Marine Weather by Nathaniel Bowditch

Once again, the very popular publication *Marine Weather* by Nathaniel Bowditch, is available from the PMO's. The book is packed with information for the mariner about meteorology and oceanography, and contains sections about observing, cyclones, tides, currents, waves, breakers, surf, and sea state. The National Weather Service obtained special permission from Simon & Schuster to photocopy the book. They are in very limited supply.

Nathaniel Bowditch

Los Angeles PMO Visits Korean Shipping Companies

During a recent visit to South Korea, Bob Webster, PMO Los Angeles, presented plaques of appreciation to Korea's two largest shipping companies — Hyundai Merchant Marine Co., Ltd., and Hanjin Shipping Co., Ltd. Hyundai Merchant Marine has 10 ships in the NWS VOS program, while Hanjin Shipping has 12 VOS vessels. Both companies have lent strong support to the VOS program, and have indicated willingness to expand their participation in the future. Receiving the plaques from Bob were Mr. B.S. Yoon (top left), Manager of Vessel Operation and Control Department of Hanjin and Mr. J.Y. Kim (top right), Assistant Senior Manager of the General Administration Dept. of Hyundai Merchant Marine Co.

The Envelope Please

The winners keep coming in for the Outstanding Performance Awards for 1988, and nothing could make the National Weather Service happier. On the previous page (far left) the ***Sea Lion*** gets her prize; from left to right, 3/M Jim Moore, C/M Ken Donahue and Captain Tony Hogg (missing is 2/M Blaine Collins). Also on the previous page (near left) is Commander Wayne Perrymen (left) Captain of the NOAA ship ***Oregon II*** receiving the award from the OIC of the NWS office at Galveston, TX, Michael Young. Collecting the plaque for the ***Chevron Mississippi*** (top left) were, left to right, 3/M Sunny Rude, Captain Tony Farray and 2/M Les Busch. The next three photos are from the Jim Nelson portrait gallery. At lower left Jim is seen presenting the award to Captain Raul Gomez Sarabia, Master of the B/M ***Jalisco***. Jim (top right) once again mugs for the camera aboard the ***Sea–Land Commitment*** while presenting an award to Captain Richard (Rick) Barry and Chief Officer Barry Constanzi (left). Photo courtesy of Sea-Land Service Inc. Finally, guess who (bottom right) in the middle of the crew of the ***Charlotte Lykes*** as they receive their well deserved plaque. From left to right are Jay Horwath, MREO, Michael McCormick, 3/M, Captain Jim Brasier, NOAA's leading ham, Ken Montour, 2/M, and Pierre Lesne CH/M.

New VOS Program Recruits

During the period July – September, 1989, 52 vessels were recruited by the PMO's into the VOS program. We thank these vessels for joining the program and look forward to their participation as weather observers.

Adrian Maersk	OYIT2	Maersk Line
American Trader	WNEJ	Amer Trading & Transportation
Arctic Discoverer	V2ZD1	E. RZ. R. A.
Astro Venus	DVHL	NYK Car Carrier Mktg Ops GP4
Atla	ELIF5	Fairmont Shipping Ltd.
Battersea	C6HS6	Wallem Ship Management Ltd.
Belgian Senator	DDUC	Reederei Heyo Janssen
Bobel Star	KRPP	Nobel Star
Cattleya Ace	3ELG6	Strachan Shipping Co.
Challenger	ELDB7	Transmarine Navigation Corp.
Chevron Star	ELFT	Chevron Shipping Co.
China Container	BMDJ	OOCL (USA) Inc.
Conti Bavaria	3ESP4	Gulf & Atlantic Maritime Svcs.
David Packard	ELEM	Chevron Shipping Co.
Elizabeth SK	ELIR7	Thome Ship Mgmt., Inc.
Esso Puerto Rico	C6FB5	Esso Intl. Shpg., Bahamas Co., Ltd.
German Senator	DDUR	Reederei Heyo Janssen
Gulf Sentry	NSTY	USCG Map Miami
Hakone Maru	JJZC	Matson Agencies, Inc.
Hanjin New York	3EPU4	Hanjin Shipping Co.
Happy Valley	A8FV	Orient Ship Management
Harmony Stove	LAQO2	Norton Lilly & Co., Inc
Kokua	WTW9250	Sause Bros Ocean Towing
Lago Peten Itza	TGMP	Marine Mgmt. & Consulting Ltd.
Leros Courage	C4XL	Leros Management S. A.
Maersk Titan	9VAL	Maersk Line
Marina Ace	3EQH5	Williams Dimond and Co.
Mathilde Maersk	OUUU	Maersk Line
Mette Maersk	OXKT2	Maersk Line
Mindanao Sampaguita	DVFE	Cascade Shipping Co.
Morelos	XCMG	Trans–America SS Agency
National Honor	DZDI	Inter Pacific Shipping Corp.
Nedlloyd Bahrain	PGEH	Nedlloyd Lines
Nedlloyd Baltimore	PGDT	Nedlloyd Lines
Nedlloyd Bangkok	PGDV	Nedlloyd Lines
Nedlloyd Barcelona	PGEM	Nedlloyd Lines
Pacific Sentry	NOKL	USCG Map Maimi
Pacocean	ELJE3	Lasco Shipping Co.
Pacstar	ELIS9	Lasco Shipping Co.
Prince of Tokyo 2	3EUU6	EAC Transport Agencies
Rana M	C6HY3	Thome Ship Mgmt. PTE., Ltd.
Sanko Prelude	3EDP3	Cascade Shipping Co.
Santa Marta	ZFCH	Southern Steamship Co.
Star Fuji	ELEL2	Star Shipping Inc.
Star Geiranger	ELFI8	Star Shipping Inc.
Sunward II	ZGRG	Barber Ship Mgmt., Ltd.
Talisman	LANC2	B.C.P. Ship Management
Texaco Veraguas	HOFR	Texaco Marine Service, Inc.
Texaco Westchester	C6DK	Texaco Marine Service, Inc.
USCGC Sherman	NMMJ	U.S. Coast Guard
USNS Audacious T–AGOS II	NJMR	Master USNS Audacious
USNS Chauvenet TAGS 29	NYGG	L.S.C. Marine Inc.

This discarded net is done fishing. But it's not done killing.

When worn fishing nets or other plastic gear is dumped or lost in the water, something else happens: animals die.

Seabirds get caught in nets when diving for food, and drown. Other marine animals become entangled in them and slowly strangle.

Discarded nets and traps even compete with you, by needlessly catching and killing millions of pounds of potentially valuable fish and shellfish.

In addition, plastic wastes can foul propellers and block cooling intakes, causing costly vessel disablement.

Over 100,000 tons of plastic fishing gear are dumped into our oceans every year. This critical issue is destined to attract increasing public and government scrutiny if we fail to take action to solve it.

So please, alert your dock operators that you'll need trash facilities, because you're saving your plastic trash and worn out gear for proper disposal on land. That's not all you'll be saving.

To learn how you can help, write: Center for Environmental Education, 1725 DeSales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Environmental Education
The National Oceanic and Atmospheric Administration
The Society of the Plastics Industry

These summaries were kindly provided by the Fiji Meteorological Service.

Tropical Cyclone Eseta
December 16–25 1988
Rajendra Prasad

Tropical Cyclone Eseta formed from a depression, which originated in the monsoonal trough just north of Vanuatu on the 15th of December. The depression persisted for over a week. It moved southward over Vanuatu and New Caledonia, curved toward the north and then east, and gradually intensified into a tropical cyclone on the 23d of December.

Eseta maintained tropical cyclone characteristics for less than 2 days, becoming a depression on the 25th. The system reached peak intensity around 2100 UTC on the 24th with maximum average winds estimated at 55 knots and gusts to about 75 knots close to its center.

During its lifespan as a tropical cyclone, Eseta remained at sea thus sparing any land areas from its full impact. The system caused strong, gusty winds and prolonged heavy rain–fall over the Fiji Group between the 22d and 26th, as it passed about 300 miles southwest of Nadi. Nadi Airport recorded average winds up to 30 knots on the 24th with a peak gust of 51 knots at 7:00 a.m. Fiji time. No casualties or damage was reported.

The system affected New Zealand as an extratropical storm causing heavy flooding over parts of its North Island.

Tropical Cyclone Deliah
January 1–4 1989
Pradeep Kumar

Tropical Cyclone Deliah formed from a depression embedded in the South Pacific Convergence Zone (SPCZ). It developed close to Willis Island in the Coral Sea on the 1st of January 1989. The cyclone lasted for about 4 days as it moved towards Vanuatu, then curved southeastward. It passed between New Caledonia and Loyalty Islands as it attained storm intensity.

At its peak intensity, around 1500 UTC on the 2d, Deliah had maximum average winds estimated at 60 knots with gusts to about 80 knots. At this time Deliah was located between New Caledonia and the Loyalty Islands and was moving southeastward at about 20 knots.

Deliah maintained tropical cyclone characteristics for about 4 days before becoming an extratropical storm far southeast of New Caledonia. It maintained gale intensity till the 7th as it moved southward and passed close to the northern tip of New Zealand.

The center of Deliah passed about 20 to 30 miles off the northeast coast of New Caledonia between 0600 and 1800 UTC on the 2d, while the cyclone was at peak intensity. Although no reports are available the damage is expected to have been considerable in these areas.

Tropical Cyclone Fili
January 2–7 1989
Sudha Singh (Miss)

Tropical Cyclone Fili started as a small depression far to the east of Samoa and had a relatively short lifespan spending most of it over water.

It reached its maximum intensity after recurving and passing close to Niue on the 4th. It continued on a steady southeasterly track and moved out of Nadi's area of responsibility, for issuing maritime warnings, on the 6th. Fili is estimated to have attained storm intensity with maximum average winds of 55 knots and gusts to 80 knots close to the center.

No damage reports were received from any island groups but it appears that the system caused some minor damage over Niue, consistent with strong winds below gale force.

Tropical Cyclone Gina
January 6–9 1989
Satya Kishore

Tropical Cyclone Gina originated within an active convergence zone west of Samoa on the 6th of January. Gina was a minor cyclone with a very compact circulation. It had a relatively short life span which was spent over open waters between Samoa, Tonga and Niue. Gina acquired peak intensity around 0600 UTC on the 8th of January when the maximum average winds near its center were estimated at 45 knots. The Samoan Islands sustained some minor damage from the prolonged period of heavy rain and a brief period of gale force winds as Gina passed to the south. The southern parts of Western Samoa and Tutuila, the main island in American Samoa, were affected by a brief period of gale force winds. The rest of the Group was exposed to strong and gusty winds.

Reports from Western Samoa indicate that most damage occurred from the prolonged heavy rain associated with the cyclone. Widespread flooding and landslides caused damage to roads and bridges in Western Samoa, estimated at about $5 million (US dollars). Reports of some minor damage to structures and crops in American Samoa was also received.

Tropical Cyclone Harry
February 7–19 1989
Mukul Manoj Singh

Tropical Cyclone Harry evolved from a depression in the monsoonal trough about 400 miles west of Vila. The system moved eastward, and later westward, crossing over the northern parts of New Caledonia. It made a clockwise loop before heading in a southeast direction.

Harry attained hurricane force by 2100 UTC on the 10th. Maximum sustained winds were estimated at 90 knots with gusts to 120 knots. It maintained hurricane force winds from 2100 on the 10th to 0600 UTC on the 17th.

The northern parts of New Caledonia and nearby smaller islands were severely affected while the southern islands of the Vanuatu experienced marginal gales. Harry passed over the northern parts of New Caledonia with hurricane force winds close to its center. Though no reports of damage were available from New Caledonia, its northern sections and the nearby smaller islands are likely to have felt very destructive winds and heavy rain. The southern part of Vanuatu experienced marginal gales but escaped any significant damage.

Harry was one of the major cyclones of 1988/89 season. It maintained hurricane intensity for a long period and is likely to have had severe impact over parts of New Caledonia.

Tropical Cyclone Ivy
February 23–March 2, 1989
Satya Kishore

Tropical Cyclone Ivy formed near northern Vanuatu on the 23d of February. Ivy moved away from Vanuatu but later recurved toward the southeast and passed close to southern Vanuatu at hurricane intensity.

Ivy reached its peak around 0000 UTC on the 27th when the maximum average winds near its center were estimated to be 75 knots. It maintained hurricane intensity for about 2 days before it finally moved westward, toward New Caledonia, and dissipated, north of the 25°S.

Ivy caused considerable damage to the island of Aneityum in the southern part of Vanuatu when it passed very close, with hurricane force winds. during the evening of the 26th. Reports received from Vanuatu indicate substantial damage to food crops, houses and other facilities. Flooding and landslides augmented the damage done by the high winds but, fortunately, there were no casualties.

Tanna and the nearby island of Futuna, which did not fall directly in the path of the cyclone, also sustained extensive damage to crops but suffered less structural damage. Some houses were damaged and the airfield on Tanna was closed for some time because of flooding.

Tropical Cyclone Judy
February 23–28 1989
Rajendra Prasad

Judy was a very small but intense cyclone that originated as a depression south of Tahiti on the 24th. It initially moved southwestward then westward passing close to the island of Mangai in the Southern Cooks; it finally curved southward and rapidly lost intensity and tropical cyclone characteristics.

Though there was some indication of a system in the area, from satellite imagery, the existence of Judy was not evident at the surface until late on the 25th when the system was about 200 miles east southeast of Southern Cooks. This was partly due to its formation in a relatively data sparse area but more because of its miniature size and very tight circulation. The rapid rate at which Judy dissipated is rarely witnessed in this part of the world.

Judy is anticipated to have reached peak intensity late on the 26th with maximum average winds estimated at 65 to 70 knots. The only land area affected from the cyclone was the island of Mangaia in the Southern Cooks, which was reported to have experienced estimated maximum average winds of 55 knots at 1400 UTC on the 26th when Judy was located about 30 miles south southwest of the island. The lowest pressure recorded was 997.5 millibars.

Judy was one of the most peculiar cyclones to have occurred in this part of the globe. Its miniature size and occurrence in a relatively data–sparse area made the system virtually undetectable until late in its development stages.

Tropical Cyclone Kerry
March 29– April 3 1989
Neville L. Koop

The depression that was to become Tropical Cyclone Kerry formed in the monsoonal trough, just south of Samoa, on the 29th of March. Subsequently the system moved steadily southwestward for the next 3 days and attained tropical cyclone status on the 1st of April. A short time later Kerry came under the influence of the mid latitude westerly flow and it recurved eastward, then southeastward. The system peaked at about 1800 UTC on the 1st of April when the average winds were estimated at 50 knots. It maintained this intensity until 0000 UTC on the 3d.

During its entire lifespan, Kerry remained over water and thus spared land areas from its full impact. However strong, squally northwest winds and some heavy rain were experienced over Fiji from March 30th to April 2d. At the time the system was still a depression but deepening rapidly as it passed about 100 miles west–southwest of Kadavu. No casualties were reported as a result of the cyclone. However strong winds caused some damage to sugar cane and rice crops over western Viti Levu, while there was some minor local flooding due to heavy rain. Tropical cyclone Kerry dissipated rapidly as it moved over cooler waters late on the 3d.

Kerry was a minor, well behaved cyclone that affected Fiji during its formative stages. It attained its maximum intensity well away from any

large land area and thus caused no major destruction. Tropical cyclone status was not reached until the system neared 22°S; this was the primary reason the system maintained cyclone characteristics for only 3 days.

Tropical Cyclone Lili
April 6–12 1989
Sarwan K. Day

Tropical Cyclone Lili originated from a depression over the Coral Sea on the 7th of April. It initially moved southeastward toward Vanuatu. It gradually curved toward the south after reaching hurricane intensity around 0600 UTC on the 8th, about 130 miles west northwest of Espiritu Santo.

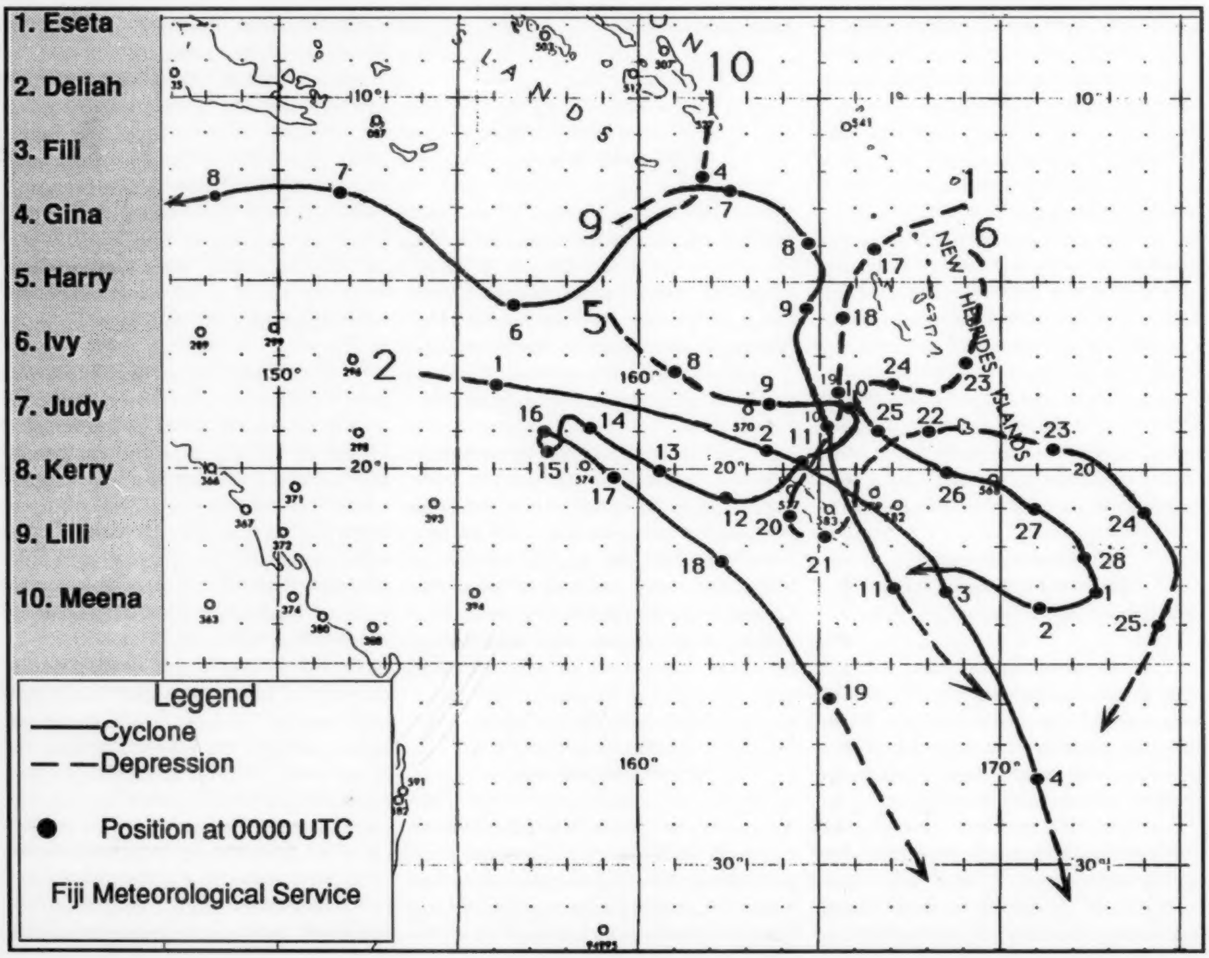
Lili maintained hurricane intensity over the next 2 days as it moved southward. At peak intensity Lili was estimated to have average winds of 75 knots close to the center and storm force winds within about 40 miles of the center. It passed about 200 miles west of Vila and as it approached the east coast of New Caledonia it began to weaken slowly.

Lili initially posed a threat to Vanuatu but fortunately it turned toward the south and the gales narrowly missed Vanuatu. It caused considerable structural damage particularly over the east coast of New Caledonia and the Loyalty Group. Widespread flooding, landslides, disruption to power supplies and other domestic services were reported. No report of any casualties has been received.

Tropical Cyclone Meena
May 4–9, 1989
Satya Kishore

Tropical Cyclone Meena was a late season cyclone that formed south of the Solomon Islands on the 4th. The cyclone initially moved toward the southwest as it developed but later curved westward and moved toward northeastern Australia.

Meena was a small tropical cyclone of gale strength only. At peak

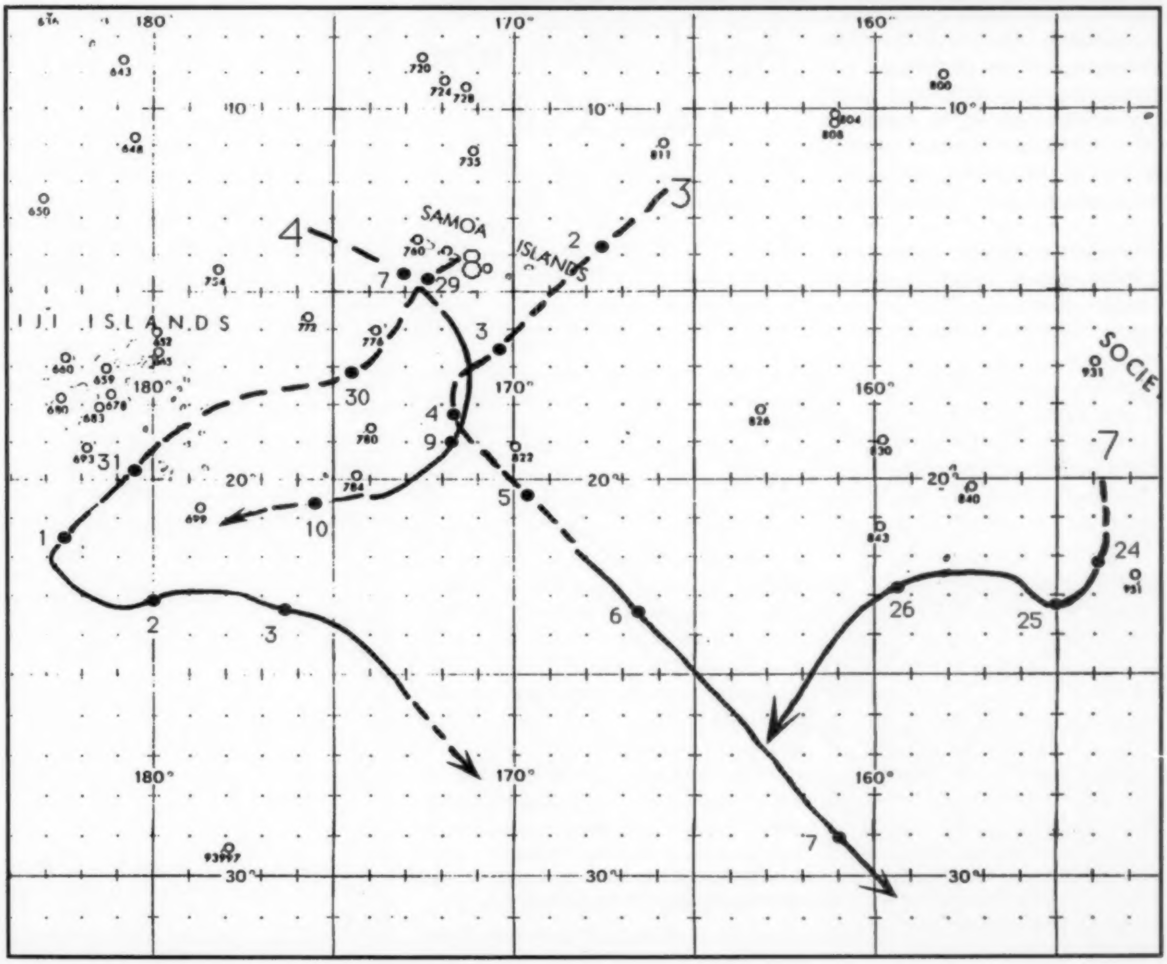


intensity, around 06000 UTC on the 6th, it is estimated to have generated average winds of 45 knots near its center. The cyclone maintained gale intensity for 6 days before it passed over Cape York Peninsula in northeastern Australia and weakened rapidly.

Meena may have caused some minor damage along the eastern coasts of Cape York Peninsula where it made landfall. The only other place to be affected by Meena was the southeastern part of the Solomon Islands, which experienced heavy rain and strong and squally winds as the convective cloud bands associated with the cyclone passed over the region.

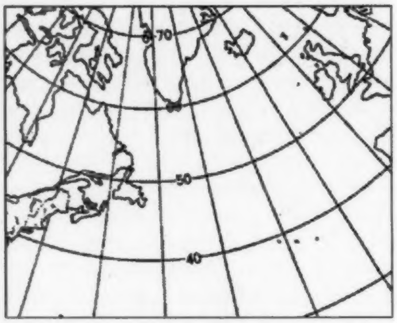
What's in a Name?

Tropical cyclone terminology ~~can~~ get very confusing at times, with words such as disturbance, depression, cyclone, hurricane and typhoon. That's not even counting local terms like baguio and willy-willy. In the U.S., Tropical Cyclone is the generic term and may include tropical depressions, tropical storms and hurricanes. Or it may just include tropical storms and hurricanes. Cyclones in the U.S. are often thought of as winter or extratropical systems. However in areas such as the South Pacific, South Indian and North Indian Oceans, cyclones are the equivalent of hurricanes or' typhoons, where maximum winds are 64 knots or more. Also in these regions depressions are storms with winds of 34 to 63 knots or the eqivalent of our tropical storms— but different from our tropical depressions. As if this wasn't confusing enough, some areas have refined depressions further into severe depressions, which, I think, are depressions with winds between 50 and 63 knots. This may be more important for proper meteorological etiquette than as any real point of concern. For example if you are in a bar in Fiji and bragging about how many cyclones you been through it might carry a lot more weight than ~~if~~ you made the same statement in Miami.



North Atlantic Weather Log April, May, and June 1989

April— Usually a transition month, this time around April looked more like a summer scene (fig 1). The Azores–Bermuda High dominated a good portion of the North Atlantic and was some 5–mb deeper than normal. The Icelandic Low, as is normal, was spread out from Labrador to Iceland. It also covered Europe, which is not normal and resulted in negative anomalies up to 6 mb. The steering levels at 700 mb indicated a general east northeastward flow, so that ideally a system from New York would end up in the Bay of Biscay.



On This Date— April 2, 1975— The northeastern U.S. was in the grip of a severe storm, which produced hurricane force winds along the coast. In New Hampshire and Maine it dumped 2 to 3 feet of snow. Atop Mt. Washington winds gusted to 140 mph.

Extratropical Cyclones— Storm activity in this normally dangerous month was below normal. The Azores–Bermuda High made up of several intense systems was particularly dominant during the first half of the month.

Early on the 25th thunderstorms rolled across the upper Great Lakes, north of a stationary front. Hail and strong winds were reported as they moved from northwest Wisconsin across northeast Illinois and lower Michigan into northwest Ohio. Golf ball–size hail pelted Boone County, Il while dime–size hail covered the ground at O'Hare International Airport in Chicago. Winds gusted to 69 mph at Woodstock, Il.

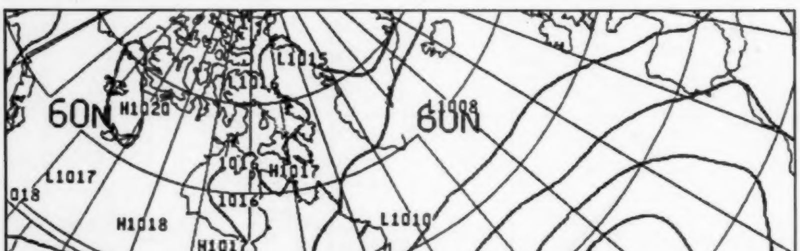


Figure 1.— The Azores–Bermuda High gave a summer–like appearance to the North Atlantic in April, resulting in below normal storm activity.

❶ ❷ While large high pressure areas usually bring fair weather, their intensity or gradient can help make a routine storm dangerous. Around the 3d this long–lived system sprung to life just east of Labrador. It was enhanced by a double–centered 1032 –mb High to the south and southwest. By 1200 on the 4th, a 980–mb Low was heading toward the Denmark St. On the other side of Greenland, in the Davis St, the ***Svea Atlantic*** was buffeted by 44–kn north northwesterlies at 1200 and 1800. Southeast of the center, the KNDB (63°N, 26°W) was nailed by 40–kn south southwest winds in 20–ft swells, at 1800 on the 4th. The storm stalled on the 5th and 6th southwest of Iceland. It also weakened and another Low from the U.S. slipped between it and a 1034–mb High.

This Low aided by an intensified pressure gradient produced some locally rough weather as it skirted the northern edge of the High and then turned southeastward toward Portugal. Later on the 7th, and early on the 8th, several vessels including the YUGV, ***Rhine Forest***, and the ***Theodore Storm*** ran into winds of 50 to 60 kn near the center. In fact the ***Kapitan Dubinin*** (42°N, 23°W) ran into a 64–kn northwesterly in 26–ft seas. By 1200 on the 8th the storm's 980–mb center had crossed the 15th meridian. Winds of 45 to 60 kn in seas of 20 to 30 ft were being encountered. The ***Happy Cecilie*** (42°N, 22°W) was pummeled by 60–kn north northwesterlies while battling 40–ft seas with a slope of about 1/12 – fairly steep. Storm No. 2 finally weakened as it moved into Portugal on the 9th.

Meanwhile storm No. 1 was

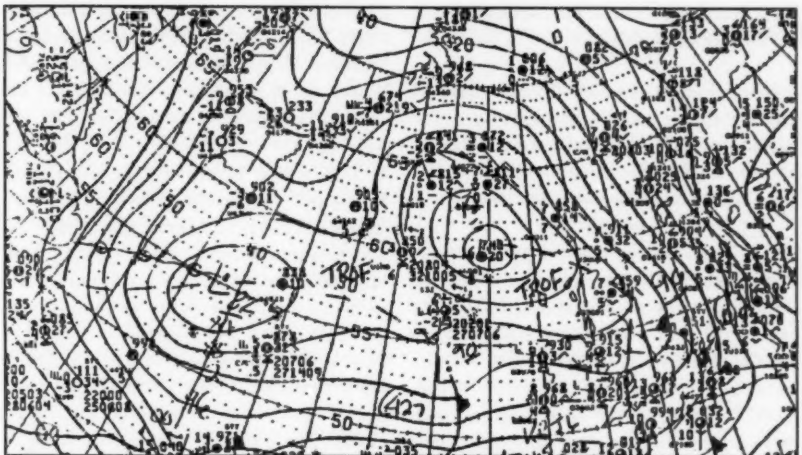


Figure 2.— Storm No. 1 got its second wind. On the 10th its tightest gradient was to the east of the center.

getting its second wind. On the 9th central pressure was down to 976 mb as it clipped Reykjavik, Iceland and dipped southward. The following day a 972–mb center was recurving northward (fig 2). At 1200 on the 9th, the TFKD (67°N, 23°W) reported in with 52–kn north northeasterlies. The storm headed back across Iceland on the 11th and its central pressure dipped to 966 mb before it began to fill. On the 10th its tightest gradient was to the east of the center, where a number of vessels were reporting 40–to 50–kn winds. The system hung on until the 14th.

❸ Early on the 11th a storm developed over Iceland. It became part of the large circulation of storm No. 1. Moving northward it intensified very rapidly. By 1200 on the 11th its 968–mb center neared the 55th parallel, at about 6°W, while some 600 mi to the north lay the 966–mb center of storm No. 1. This potent combination was enough to create havoc over the North Sea and the British Isles. Wales was particularly hard hit. In Wales strong winds and heavy rains closed roads while vessels were battered in the Irish Sea. Cardiff Weather Centre reported gusts reached 98 mph in Milford Haven while Swansea and Aberporth experienced winds up to 80 mph. At 0600 on the 11th the DBFP (50°N, 10°W) sent in a 969–mb reading as she battled 54–kn west southwesterlies. This was confirmed by the ***Ael America*** and the ***Irving Forest*** nearby, which ran into 52–kn winds in 20–to 26–ft seas. At 1200 the ***Corystes*** radioed 60–kn southwesterlies near 51°N, 5°W. At 1800 the ***Esso Aberdeen*** (54°N, 5°W) reported a 967–mb pressure in 50–kn westerlies. However the center moved rapidly northward and began to fill on the 12th.

❶ Here are two storms, which, at first glance, don't look like much, but combined to produce some real problems for shipping on the 15th and 16th in the eastern North Atlantic and the Bay of Biscay. Both came to life on the 13th. By the 15th the northern system was absorbed by the southern storm into a single 990–mb center near 48°N, 10°W. The first clue that this was a potent system came from the GNDB (48°N, 22°W) which encountered a 55–kn northerly at 0000 on the 15th. This might have been thought to be a mistake or exaggeration except nearby the ***Geesthaven*** hit a 52–kn blow. At 1200 the ***Andes Highway*** reported a 50–kn westerly while the ***Jean Charcot*** (45°N, 16°W) came in with a 48–kn wind in 26–ft seas. The storm was for real. By 1800 several vessels in the southeastern part of the Bay of Biscay, off the north coast of Spain, ran into winds that ranged from 45 to 60 kn in seas that ran 15 to 25 ft. Pressures however were in the 995–to 1012–mb range. This relatively small system pounded the waters of the Bay of Biscay well into the 16th as it moved into France. At 1200 on the 16th the ***Helene*** (45°N, 40°W) was nailed by 56–kn westerlies in 26–ft seas. At 06000 several vessels including the ***City of Plymouth***, ***Canberra*** and the ***Ernst Thalmann*** reported winds in the 50–to 60–kn range. By 1800 the gales were still blowing but there was little evidence of storm force winds.

Tropical Cyclones— As far back as 1492 there is no record of an April tropical cyclone.

Casualties— During the Wales storm of the 11th, the Milford Haven Coastguards helped prevent casualties by directing the ***Karina***, which was listing badly, to shelter in the Bristol Channel. They also assisted the ***Maringa***, which was in difficulty off St Davids Head. On the 16th the ***Hystein*** developed a severe list in the Bay of Biscay storm. The 8–man crew was picked up from liferafts by the ***Neidenburg***. Several days later 16 containers and 18 pontoons, from a couple of vessels caught in the storm, were spotted drifting off Cape Finisterre. On the 19th, 23 crewmen were rescued after the British registered, bulk carrier ***Star of Alexandria*** sank 400 mi southeast of Cape Cod. She was carrying a load of cement and sent out a distress signal after taking on water in 7–ft seas and 35–kn winds. Survivors were picked up by the ***Ravenscraig***.

Unless otherwise stated all times are Universal (UTC). The number next to the storm summary corresponds to the same number on the track chart. The Monster of the Month is a title given to a storm that has been particularly hazardous to shipping. The tropical cyclone summaries are based upon information provided by the National Hurricane Center, Joint Typhoon Warning Center and the Hong Kong Royal Observatory. They are detailed but should be considered preliminary until final reports are issued.

May— On the climatic charts an extension of the Azores–Bermuda High settled in from Nova Scotia to eastern Europe (fig 3). This region is usually the domain of a weakening Icelandic Low, so the result was a band of positive 6 to 7 mb anomalies. Since this covers the northern shipping lanes it resulted in better than average conditions for vessels traversing these routes. The High was not quite so apparent over the east central North Atlantic where anomalies were on the order of -3mb— nothing tragic but a few storms did manage to fill the void between the Azores and the Cape Verde Is. The upper level steering (700 mb) was generally oriented in a west southwest–east northeast direction. In this idealized picture a storm leaving New York would arrive in Iceland. A look at the track chart shows none did.

On This Date — May 31, 1889 — The Johnstown disaster occurred a century ago. This was the worst flood tragedy in U.S. history. Heavy rains collapsed the South Fork Dam sending a 30–ft wall of water rushing down the already flooded Conemaugh Valley. The wall of water traveling at speeds up to 22 ft per sec swept the land clean. Some 2100 people perished.

Extratropical Cyclones— With ridge of high pressure often extending over the northern shipping lanes, much of the storm activity was pushed into the Denmark St and Norwegian Sea.

❶ This storm developed early on the 12th near Frobisher Bay and Baffin Is. The system headed east southeastward across the Davis St and over Kap Farvel during the day. By 1200 on the 13th its central pressure was down to 973 mb. ***OSV C*** (53°N, 36°W) was grappling with 40–kn westerlies all day long in swells that built to 30 ft before the day was through. At 0000 on the 14th the ***Falcon*** some 400 mi south of the storm's center hit 44–kn westerlies in 13–ft swells. By 0600 her winds backed to the west southwest and 6 hr later they increased to 52 kn while swells built to 16 ft. Nearby, at 1200, the VSBG9 reported 42–kn winds in 20–ft swells. During the day the storm turned northeastward toward Iceland. ***OSV L*** (57°N, 20°W) reported a southwest 43–kn blow with a 990–mb pressure in 20–ft swells, at 1600 and 1800. Their strongest reading reached 48 kn in 23–ft seas with a slope of about 1/10, at 2100. She continued to battle 40–kn winds into the 15th as the storm banged across Iceland. Its trek across the rugged island seem to weaken the storm. By the 16th pressure was up to 990 mb.

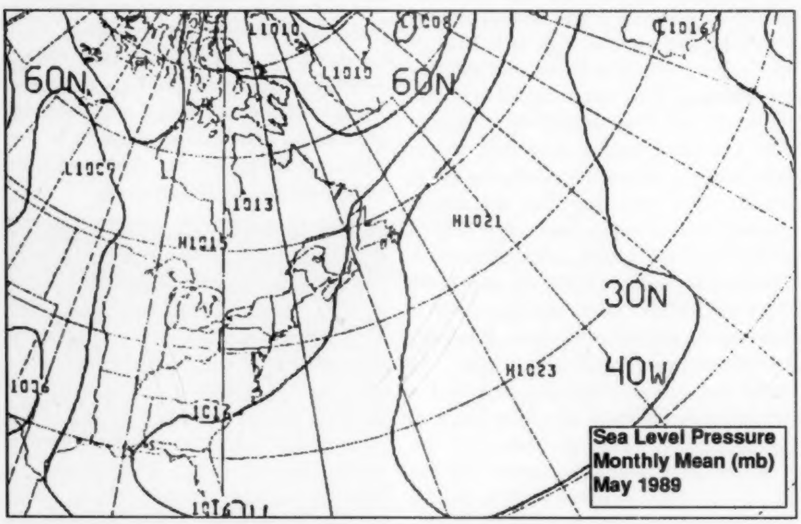


Figure 3.— The Azores–Bermuda High covered a good portion of the shipping lanes in the north, offering a degree of protection to vessels sailing these waters.

❷ This storm began on the 13th over Viscount Melville Sound in the Canadian Arctic. Except to forecasters and analysts it didn't make much of an impression as it moved east southeastward through the Foxe Basin and, on the 16th, over the Hudson St. By this time it looked more like an organized storm, with a 998–mb center. However, it didn't bother shipping until the 19th. The OUGU provided several excellent reports in the vicinity of Kap Farvel, Greenland through the 19th. At 0000 she encountered 47–kn northerlies, which 6hr later backed to the northwest and by 1200 were out of the west northwest. The storm in the meantime was turning northward and slowly intensifying. By 1200 on the 20th its 984–mb center was in the process of turning a counterclockwise loop. By the 21st, at 1200, the pressure had dipped to 973 mb. The system was dominating weather in the Denmark St and was affecting a portion of the northern shipping lanes. However except for a few isolated gales, most vessels were able to avoid this low pressure system. On the 22d the ***Polyarnyy Krug***, some 300 mi southeast of the center, ran into gales in 13–ft swells while a land station on the coast of Greenland, north of the center, reported 35–kn easterlies. By the 22d the storm weakened as the loop was completed.

Tropical Cyclones— Since 1931 some 12 tropical cyclones (tropical storms and hurricanes) have occurred in the North Atlantic Basin in May. Of these just two (1951 and 1970) have reached hurricane intensity. There were no tropical cyclones this year.

Casualties— On the 24th and 25th a cold front swept across the Great Lakes triggering some violent local thunderstorms. Late on the 24th, in a thunderstorm, the ***Lewis Wilson Foy***, outside

the Superior entrance to Duluth Harbor, measured winds to 74 mph. Duluth/Superior recorded 2 in of rain in 12 min. The following night, winds from a violent thunderstorm in Cleveland drove the *Nicolet* into the Shooters nightclub dock on the Cuyahoga River, where she also hit a pleasure boat just up river from the Conrail bridge.

June— While the center of the Azores-Bermuda High was displaced southwestward from its usual position and a little weaker than normal it still covered most of the North Atlantic (fig 4). The Icelandic Low was confirmed to Greenland and its nearby waters, hence the northern shipping lanes benefitted from pressure that was about 4 mb above normal.

On This Date— June 27, 1957—Hurricane Audrey smashed ashore at Cameron, LA drowning 390 people in the storm tide. Only a brick courthouse and cement block icehouse were left standing in Cameron. The powerful storm tossed a fishing boat weighing 78 tons onto on offshore drilling platform

Extratropical Cyclones— Storm activity was light in the North Atlantic in June.

❶ This system can be traced all the way back to the northern part of the Hudson St on the 4th. It swung across Hudson Bay during the next several days. On the 8th, after moving across Labrador, it emerged as a 1004–mb Low in the Labrador Sea. The following day it organized as it headed toward the east southeast. At 2100 on the 10th, the ***Ziemia Bialostocka*** (41°N 26°W) encountered 45–kn southwesterlies as the storm was recurving toward the north. By 1200 on the 11th its central pressure was down to 980 mb. The ***Vigilant*** (63°N, 23°W), at 1800 on the 11th, ran into a 44–kn easterly in 26–ft seas with a slope of about 1/17— not too steep. Three hours earlier she was battling 58–kn winds in a moderate shower. The system and its associated front was generating gales as far away as 1000 mi south of the center where a vessel was reporting 35–kn northwesterlies. After a brief turn westward the storm moved northeastward on the 12th but began to weaken. It remained recognizable into the 15th when it died over Iceland.

❷ The system actually came to life on the 23d just northwest of Kap Farvel. It was nothing more than a weak atmospheric wave along a front as it swung southeastward. By 0000 on the 24th, its 995–mb center was near 63°N, 34°W. The track chart picked it up at 1200 as it dipped south southeastward. By then the central pressure was down to 985 mb and it was having an effect on shipping. The ***Vyborgskaya Storona***, in the North Sea, reported a 40–kn wind in the vicinity of the storm's warm front. At 1800 the ***Discovery*** (56°N, 21°W) and the ***Zama Maru*** (57°N, 14°W) were encountering 40–kn winds also, in seas of 8 to 12 ft. The storm headed east northeastward on the 25th as pressure continued to drop. The UGIG some 200 mi south of the center reported at 982–mb pressure; the radio message indicated 78–kn westerlies, which might be a mistake. A 48–kn westerly was reported by the ***Viktar Kingisepp*** at 1800 near 49°N, 16°W. Indications are that a second center took control of the system late on the 25th. It turned toward the northwest, into the Norweigian Sea, the following day.

❸ While this Low did not appear on the track chart it was potent at the end of the month. It appears to have developed along the previous system's cold front, on the 27th, over Scotland. It moved northeastward and intensified over the North Sea. By 1200 on the 28th, a 987–mb center was located near 62°N, 5°E. The following day several reports of 43–kn winds, out of the south southwest and northwest, came in. The ships were the ***Independent Spirit***, ***Polyarnaya Zvezda*** and the ***Pioneer Murmana***. The ***Polyarnaya Zvezda*** reported a 979–mb pressure near 63°N, 1°E at 0600 on the 29th. At 1800 near 58°N, 2°W the ***Vesturland*** hit 50–kn northwesterlies. Gales continued into the 30th as the storm made its way northward across the 70th parallel.

Tropical Cyclones— Tropical Storm Allison made an appearance in the Gulf of Mexico on the 24th. This pre-

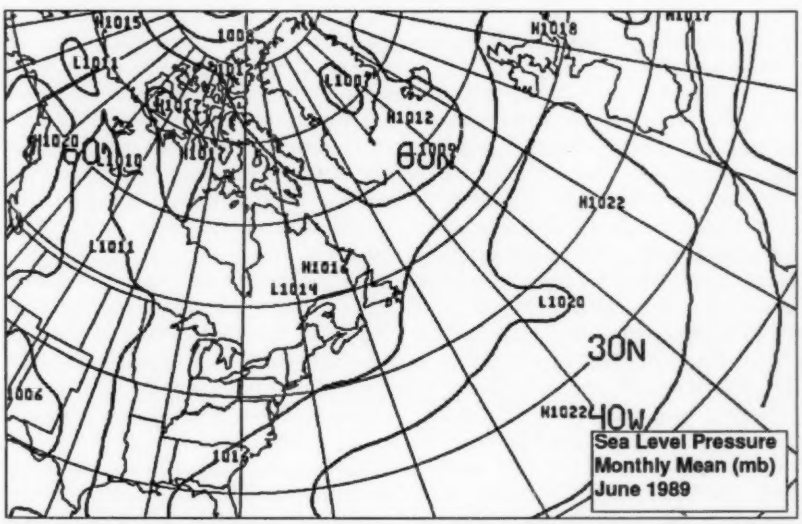


Figure 4.— Although not as strong as normal, the Azores-Bermuda High still dominates the climatic charts over the North Atlantic in June.

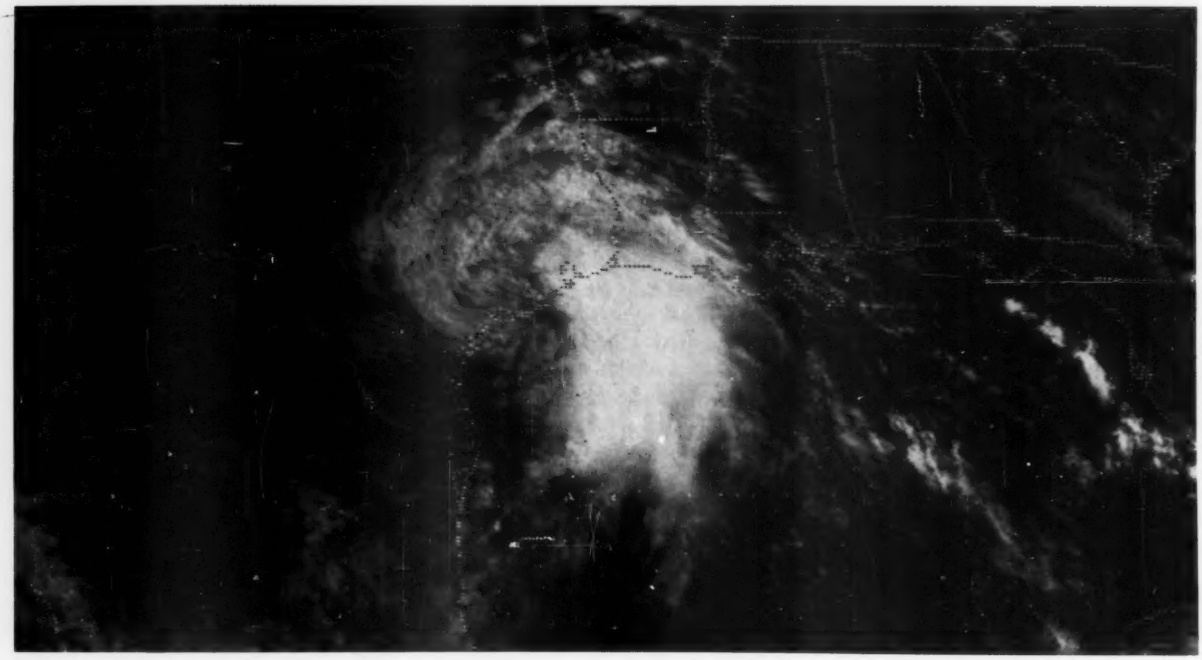


Figure 5.— Tropical Storm Allison at 1352 on the 26th of June.. This was shortly after it was upgraded to tropical storm intensity, and close to the time its center made landfall near the northeast end of Matagorda Bay. The central pressure at the time was 1002 mb.

liminary summary was kindly provided by the National Hurricane Center.

Tropical Storm Allison, although never reaching hurricane strength, proved to be very destructive. Allison caused nearly one half billion dollars in damages during a 6–day period due mainly to the flooding from the torrential rains that fell along the upper Texas coast and over the western two–thirds of Louisiana. The looping storm, which produced over 29 in of rain in a few areas of central Louisiana, will long be remembered as one of the wettest ever for the state of Louisiana.

The formation of Allison can be attributed to the remnants of the eastern Pacific Hurricane Cosme, the northern portion of a westward moving tropical wave and a strong anticyclone at 200–mb over the Gulf of Mexico. These three factors in addition to a building ridge of high pressure over the Central Plains, provided the environment that created Allison. Heavy thunderstorms began to develop over the Gulf of Mexico on the 22d and by the 23d the activity became concentrated over the northwestern Gulf. Upper air soundings indicated that the remnants of Cosme were just southwest of Brownsville, TX. During the following 24 hours, a new broad weak surface circulation developed just off the upper Mexican coast.

Based on surface observations along the coast and data from offshore oil rigs, the area of disturbed weather was upgraded to Tropical Depression Number Two at 1800 UTC on the 24th. The depression gradually became better organized during the next 2 days. Early on the 26th, Air Force reconnaissance aircraft detected a large area of 40–to 45–knot winds at 1500 ft; the depression was officially upgraded to Tropical Storm Allison at 1200 (fig 5). However, post analysis indicated the depression probably reached tropical storm strength near 0000 UTC on the 26th. At 0100 on the 26th the M/T ***Jacinth***, about 100 miles northeast of the estimated center of the storm, reported east southeast winds of 35 knots with gusts to 45 knots.

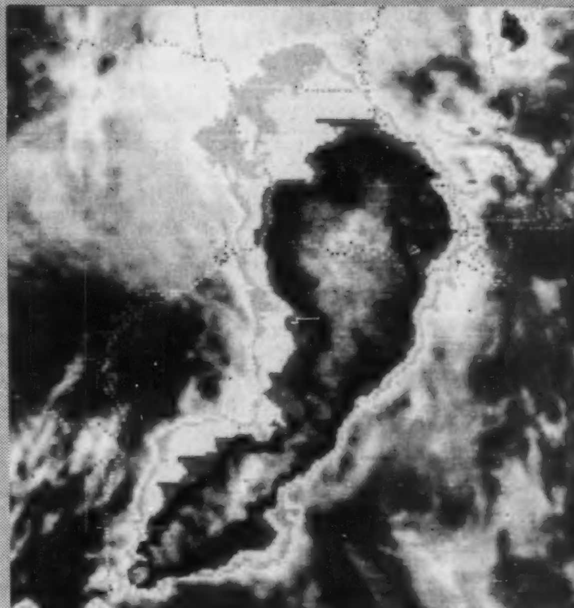
The center of Allison moved inland on the middle Texas coast near the northeast end of Matagorda Bay at 1300 on the 26th. Its pressure of 1002 mb. The central pressure continued to decrease and reached an estimated minimum reading of 999 mb at 0100 on the 27th, while the center of Allison was located just to the west northwest of Houston, Texas. Thereafter, the storm began to weaken, was downgraded to a tropical depression by 1200, and became extratropical by 0000 on the 28th.

The extratropical center moved toward the southwest through 0600, on the 30th, and crossed the northerly track that Allison had made three days earlier just to the west of Houston, Texas. After the low completed a 360° clockwise loop over western Louisiana and eastern Texas, the ridge to the north collapsed and the low center turned back to the northeast.

Winds gusts to tropical storm force occurred in the clusters of heavy

CONVECTION–COOLED SEA–SURFACE TEMPERATURES IN THE GULF OF MEXICO

Larry Peabody
WSFO, San Antonio, Texas



On June 14, 1989, a strong cold front moved off the Texas coast and across the coastal waters into the northwest Gulf of Mexico. The cold front was accompanied by an almost solid line of intense thunderstorms, as shown on the 1701 infra-red GOES satellite photo for June 14th (right).

The thunderstorms produced heavy rainfall, hail and gale-force winds as they moved offshore. Sea-surface temperatures (SST's) cooled 5°C (9°F) between June 10th (fig 1) and June 17th (fig 2), thanks to the cooling effect of the thunderstorm rain and the turbulent mixing and interchange of cooler sub–surface water with the warmer surface water.

The cooling brought about by the thunderstorms was noticeably shallow and short–lived. The SST analysis for June 24th (fig 3), 1 week later, showed the Gulf waters had returned to their pre–June 17th levels.

A similar SST cooling was documented in September of 1988 with the passage of Hurricane Gilbert across the western Gulf of Mexico. In this instance, the cooling of surface water was about the same magnitude, but the extent of cooling was more widespread and lasted much longer.

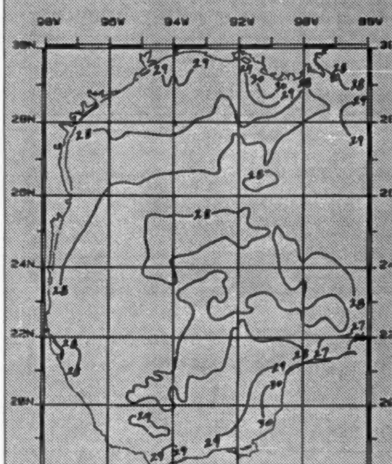


Figure 1.—June 10, 1989 Sea Surface Temperature Analysis

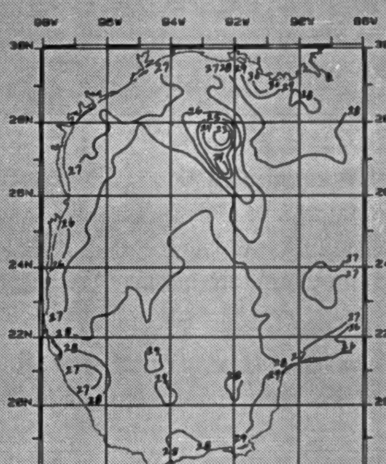


Figure 2.—June 17, 1989 Sea Surface Temperature Analysis

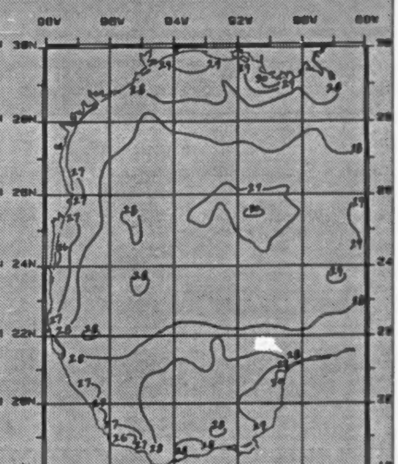


Figure 3.—June 24, 1989 Sea Surface Temperature Analysis

showers and thunderstorms as early as the 24th. Practically all of the strongest surface winds and peak gusts measured in Allison occurred in the clusters of heavy thunderstorms that developed in the right half of the tropical cyclone's circulation. Strongest winds and peak gusts from the offshore oil rigs occurred as these heavy thunderstorms crossed over the observation platforms. The oil rigs L40 and 01T measured maximum sustained winds of 50 and 40 kn, respectively, on the 26th while in heavy precipitation. Also the coastal observation site 7R5 recorded a peak gust of 60 kn in a thunderstorm.

Strongest 1-minute winds over land ranged from 35 to 45 kn with a gust to nearly 50 kn. The Galveston weather office measured the strongest 1-min wind of 45 kn at 1238 on the 26th, which was near the time Allison made landfall. The maximum wind and peak gust at Lake Charles occurred 24 hr after Allison made landfall.

Torrential rains accompanying Allison fell along the upper Texas coast and over the western two-thirds of Louisiana. Nearly 30 in fell in a 6-day period at a few locations in north-central Louisiana and amounts of 10 to 15 in were common along the upper Texas coast. The small community of Winfield, LA, had 29.52 in of rain from the 26th of June through July 1st, with 17 in falling in a 3-day period. Portions of Harris County, TX, received over 18 in.

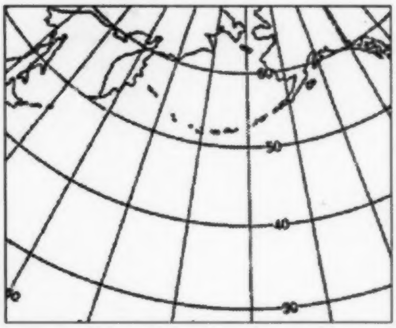
The death toll in Tropical Storm Allison was eleven. Three deaths occurred in Texas, three in Louisiana and five in Mississippi. Two teenage boys drowned in Beaumont after the rubber raft they were riding in capsized and they were swept down a drainage pipe by the flood runoff of Allison. Also an 18-year old boy drowned while swimming in Spring Creek in northern Harris County. The three deaths in Louisiana and the five in Mississippi were all by drowning.

Initial dollar-damage estimates from Allison run as high as one half billion dollars. Almost all damage occurred front the flooding produced by the heavy rains. Early estimates indicate from $200 to $400 million in damages occurred in Texas while upwards to $100 million was reported in Louisiana. Mississippi claimed nearly $60 million in damages.

Casualties— On the 19th the Russian cruise ship ***Maksim Gorkiy*** ploughed into an ice floe southwest of Spitsbergen in Greenland Sea. The ice, 4 to 6 ft thick, holed the vessel, leading to a huge rescue operation involving 700 passengers and crew.

On the 23d the ***Lady Rhoda*** (1156 tons), in dense fog, with the ***Melouia*** an sank off the Spanish coast. Only two of the ***Lady Rhoda's*** eight–man crew survived.

North Pacific Weather Log April, May and June 1989



April— Not only was the subtropical high stronger than normal, its center was displaced westward to near the dateline. This resulted in a positive anomalies up to 5 mb in this region and negative anomalies up to 6 mb to the east. In addition, the Aleutian Low was also displaced westward so it could legitimately be called to Kamchatka Low (fig 1). There was however, with all this shifting, plenty of action along the northern shipping lanes. The upper level flow (700 mb), which acts as a steering mechanism for these storms, showed a slightly wavy route from Tokyo to Vancouver Is in the ideal pattern.

On This Date —April 22, 1969 — Typhoon Susan, second of typhoon of the season, came ashore in the Philippines. It had peaked on the 22d when maximum winds reached 104 kn; the lowest pressure 943 mb.

Extratropical Cyclones— Immediately apparent from the track chart is the flurry of storm activity east of 150°W, an area vacated by the subtropical high. The Gulf of Alaska and Bering Sea had their share of weak to moderate storms as well. During the first week in April a large High dominated the weather across the central Pacific. By the 3d its central pressure rose to 1043 mb near 45°N, 180°. It extended from the tropics to the Bering St and from about 165°E to 150°W. The one potent storm during this period was forced northward into the Sea of Okhotsk. Its reach however was long enough to influence shipping along the northern routes.

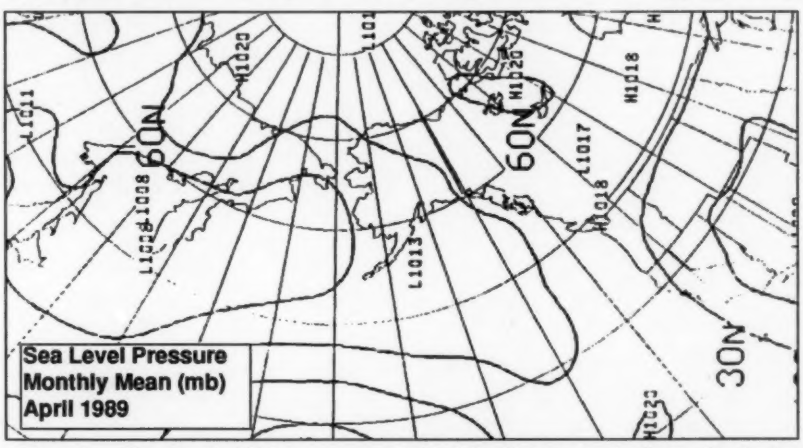


Figure 1.— The subtropical high ranges across the North Pacific Ocean during April. Despite the fact that it was stronger than normal, there was plenty of storm activity over the shipping lanes.

❶ This storm came to life on the 3d about 450 mi east of northern Honshu. It was forced to move directly northward by the large High to the east. The High also intensified the gradient and, by the 5th, ships were feeling the effect. At 0000, between 45° and 50°N from about 150° to 175°E, winds ranged from 45 to 55 kn in seas of 12 to 26 ft. Some of the vessels reporting in included the ***Neptune Sheratan, Ever Guard, Valentina, Young Soldier, Khudozhnik Vrubel, Kure Maru*** and the ***Michigan Highway.*** These conditions persisted throughout the day as the storm's central pressure dropped to 968 mb. However, it ran aground near Yamsk and weakened on the 6th.

❷ This system developed about 300 mi northeast of Tokyo on the 8th. It moved northward into the southern Sea of Okhotsk the next day then turned east northeastward. Central pressure remained above 1000 mb until the 11th, in the Bering Sea. On the 12th the system finally got organized. A few vessels over the northern shipping lanes were experiencing gales and 10– to12–ft seas. However the deepening storm was now heading northward. At 1200 on the 12th the ***Marshal Rokossavskiy*** (52°N, 160°E) reported 43–kn westerlies. Central pressure dropped to 969 mb as the center crossed the 60th parallel near the dateline on the 13th. At 1200, near 63°N, 179°E, the ***Sibirskiy*** encountered 50–kn north northwesterlies with a 975–mb pressure while nearby the ***Mys Yelagina*** hit 45–kn northerlies with a reading of 974 mb. The following day the storm made its way across Eastern Siberia and began to fill.

❸ In the same area as the previous system, this storm was detected on the 24th. Moving northeastward it deepened rapidly. The following day its central pressure was 972 mb and the inten-

sification leveled off. By 1200 on the 25th the airwaves were filled with radio reports of gale and storm force winds in the seas from 40° to 50°N between 140° and 150°E. At 0000 on the 26th the 3ESJ3 (44°N, 149°E) ran into 55-kn northerlies in 15-ft seas while a short distance away the UVKG encountered 54-kn north northwest winds. The EVB0 some 240 mi northwest of the center reported 62-kn winds with a 982-mb pressure; nearby the 8JNE hit 48-kn northeasterlies with a 979-mb reading. The system continued to plague the shipping lanes as it headed east northeastward. The circulation extended far to the south; at 0600 on the 26th the UWWE (40°N, 160°E) ran into 52-kn westerlies in 18-ft seas. The SMEN a little farther north was battling 50-kn westerlies in 30-ft seas with a slope of about 1/10— pretty steep. Storm force winds were common on the 26th. The following day there was a noticeable decrease in storm reports although gale reports were plentiful. Moving along the Aleutian Chain the storm began to weaken on the 27th.

Tropical Cyclones— Typhoon Andy made an appearance on the 17th as a depression near 7°N, 147°E. It was moving through the Caroline Islands on a westward track. The following day it reached tropical storm strength and was barely moving. It continued to intensify. By 1200 on the 19th Andy was at typhoon strength with gales extending out to 110 mi. During the day it began to track northward and maximum winds climbed to 80 kn with gust near 100 kn. Andy crossed the 10th parallel near 143°E. On the 20th the intensifying typhoon was heading toward the northeast. By 0000 on the 21st Andy reached super typhoon strength as winds climbed to 135 kn (130 kn is considered super typhoon threshold). Gales now extended to 150 mi over the open water (fig 2). In fact the ***Maersk Constellation*** some 150 mi to the northwest of Andy's center encountered 45-kn northerlies while battling 25-ft seas. Previously another vessel, at 1800 on the 20th, near 13°N, 149°E hit 54-kn southeast winds. Andy continued northeastward for the next several days. It remained at super typhoon strength until the 22d and at typhoon intensity for another day. By the 24th it became extratropical and weakened rapidly.

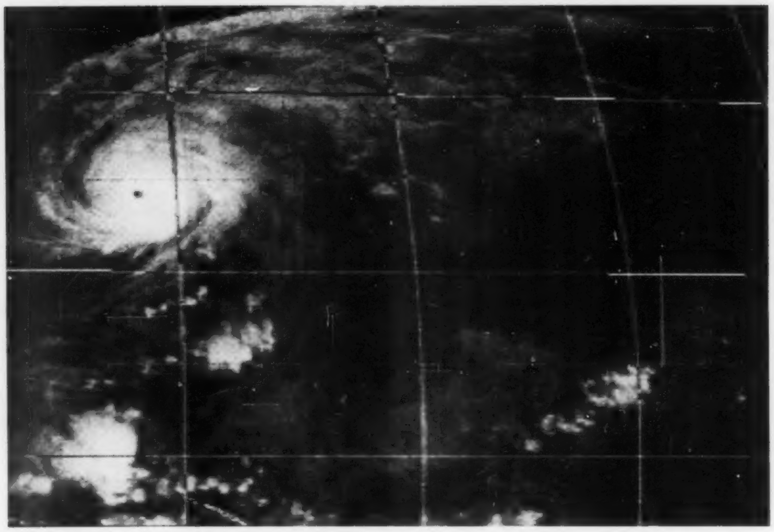


Figure 2.— Typhoon Andy roams the North Pacific as a super typhoon on the 21st at about 1200. It remained a super typhoon until the following day.

Casualties— Late in the month the ***Yaku Wasi***, from Peru to Aomori, sprang a leak in 40-kn winds and 25- to 30-ft seas east of Japan. On the 30th, 10 of the 26-man crew escaped in a liferaft, which then overturned. Six of them, including two bodies, were picked up by the ***Kyokushin Maru***. The other four were missing in the stormy seas. The 16 men who remained on board were rescued by a patrol boat on the 1st of May.

May— The climatic picture in the North Pacific was more reminiscent of July than May (fig 3). A large subtropical high extended into the Gulf of Alaska. This resulted in positive anomalies up to 7 mb over the northeastern North Pacific with near normal conditions elsewhere.

On This Date— May 25, 1961 — Typhoon Betty in the Philippine Sea, just north of Luzon, generated maximum winds of 130 kn. A short time later the typhoon barged ashore on Taiwan causing extensive damage.

Extratropical Cyclones— The large subtropical high and absence of a real Aleutian Low on the climatic charts are indicative of a lack of cyclonic activity as was the case this month.

❶ This storm was discovered some 300 mi southeast of Tokyo on the 2d. The following day it was pretty well organized and heading northeastward. At 1200 on the 3d the central pressure had dipped to 976 mb as it crossed the 40th parallel near 158°E. By this time vessels had already been reporting winds in the 40- to 50-kn range with

seas of 12 to 16 ft. The reporting ships included the ***Sanyo Maru, Alligator Liberty, Toyofuji No. 10, Lady Ulla*** and the ***Pacific Angel.*** At 0600 the ***Valdiria*** (37°N, 160°E) was blasted by 65-kn southwesterlies, with a 974-mb pressure reading. The ***Lady Ulla's*** winds had increased to 55 kn in 23-ft swells at this time. By 1200 on the 4th the 972-mb center crossed 45°N near 173°E. Six hr later the ***Novkotovsk,*** some 240 mi southeast of the center, ran into 45-kn southwesterlies, but the system was beginning to fill. Shortly after 1200 on the 5th a 986-mb center moved across the Aleutian Is chain.

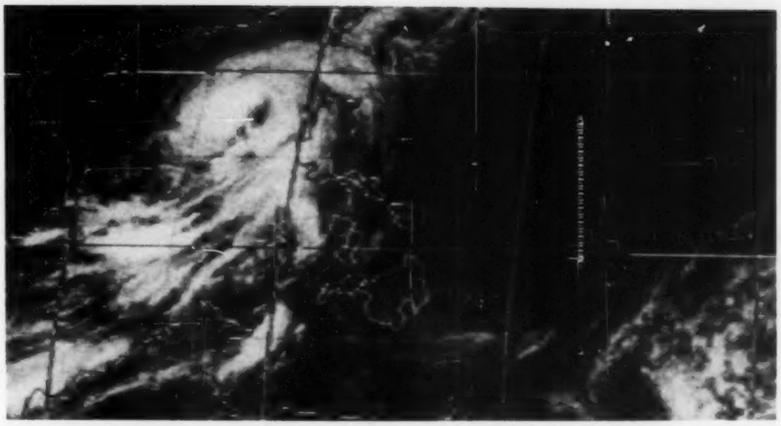


Figure 4.— Typhoon Brenda developed a ragged eye on the 19th; it is seen here at about 0300.

Tropical cyclones— The following preliminary report was provided by the Hong Kong Royal Observatory.

Brenda was the first tropical cyclone to affect Hong Kong in 1989. It developed as a tropical depression early on May 16, about 660 mi east southeast of Manila and moved steadily west northwestward at about 14 kn. Brenda intensified to a tropical storm that evening. It made landfall, over Samar in the Phillippines, early on May 17 and moved northwestward across the central part of the Philippines. Brenda passed about 20 mi south of Manila and entered the South China Sea that evening. In the Philippines, at least four vessels sank in stormy weather. Communications were also cut off and power was disrupted. According to press reports 50 people were killed or reported missing and over 5,000 were made homeless.

Over the South China Sea, Brenda slowed down to about 7 kn and intensified into a severe tropical storm on the afternoon of May 18. Brenda reached typhoon strength the next day when it was about 210 mi south southeast of Hong Kong. A ragged eye also developed (fig 4). Brenda moved northwestward steadily at about 9 kn toward the coast of western Guangdong on the evening of May 19. Windspeeds in excess of 50 kn, at about 60 mi from the center of Brenda, were reported on the morning of May 20. As it approached the coast it turned west northwestward and crossed Shangchuan Dao. Brenda then made landfall about 25 mi east of Yangjiang early on May 21. It weakened rapidly overland and dissipated about 30 mi west northwest of Yangjiang later that morning.

In Guangdong, heavy rain and squally showers caused severe flooding and landslides. About 1.42 million hectares of agricultural land were inundated. Over 1,000 houses were destroyed or damaged. According to press reports, 84 people were killed and several others were injured in western Guangdong. Macau was also affected by heavy rain and violent showers. The bridge to Taipa was temporarily closed.

In Hong Kong, torrential rain associated with Brenda resulted in 100 landslides and 118 floods. In Tsz Wan Shan, more than 20 tons of mud and rocks crashed down a hillside and struck three squatter huts, leaving two people dead. Flooding was most severe in the northwestern New Territories and 100 villagers had to be evacuated by boats in Au Tau, Yuen Long. Serious flooding also occurred in Nam Bin Wai and Ha Tsuen. About 190 hectares of farmland were inundated and huge livestock losses were incurred. Three people were killed inside a taxi in a traffic accident, in squally showers, on Clear Water Bay

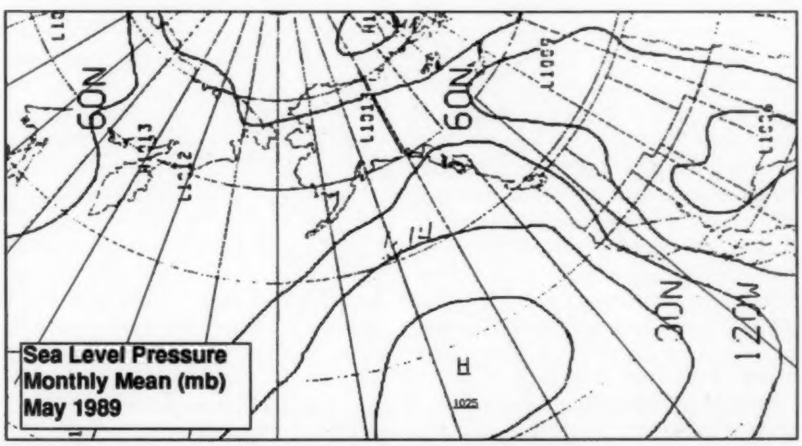


Figure 3.— A summertime climatic pattern is apparent in the May chart as the subtropical high pushes its way into the Gulf of Alaska.

Road. A crewman was drowned when his tugboat capsized off Stonecutters Island. There were also reports of fallen trees and collapsed scaffoldings. A yacht used by the armed forces for adventure training exercises sank 65 mi southwest of Hong Kong in heavy seas on May 20 after the crewmen were taken off the boat by a patrol vessel. At the airport, more than 100 flights were diverted, delayed or cancelled. Bus, tram, and ferry services were all suspended while jetfoil and hi-speed ferry services to China and Macau were cancelled. During the passage of Brenda a total of six people were killed, one reported missing, 62 injured and 50 people made homeless.

Cecil formed as a tropical depression over the central part of the South China Sea on the evening of May 22. It moved northwestward at about 12 kn initially and intensified rapidly. By the next afternoon it had attained severe tropical storm intensity and changed to a more west northwestward track at about 7 kn. A ragged eye developed on May 24 and Cecil became a typhoon. On the evening of May 24, Cecil turned southwestward. It made landfall about 58 mi southeast of Danang early the next morning. Turning northwestward again, it weakened rapidly. Cecil dropped to tropical storm intensity about 55 mi northwest of Danang and moved westward into Laos. It finally weakened into an area of low pressure about 100 mi west northwest of Danang on the evening of May 25.

According to press reports, Cecil brought torrential rain to the central part of Vietnam and caused catastrophic floods there. In the city of Hue, streets were under 6 ft of water. In the central provinces of Vietnam, 140 people were reported killed and about 600 missing. In addition, about 36,000 houses and 150 schools were destroyed, leaving 150,000 people homeless. About 700 fishing boats sank or were damaged. There were also reports of waterworks and dams being destroyed. The remnants of Cecil also brought heavy rain to the central and northeastern parts of Thailand.

Casualties— The 14,663-ton car carrier ***Orange Coral*** sank in the Seto Inland Sea, off Japan, on the 2d after colliding with the ***Shamrock Ocho*** in dense fog. All 18 of her South Korean crew were saved. The collision occurred in shallow water, leaving the masts and funnel of the vessel above water. Her cargo included 138 vehicles. The ***Al Shamiah*** suffered heavy weather damage during Brenda on the 20th. South of Manila, the launch ***Albert*** sank in Brenda; 3 people drowned, 30 were missing and 6 were rescued. During the same storm 10 people were killed when a motor boat capsized off the Catanduanes and the ***Zambles*** sank 110 mi south of Manila; 19 of the 24 crewmen were rescued.

June— As is normal, the subtropical high dominated a good part of the North Pacific (fig 5). It was even a little stronger in the central waters resulting in an area of +4 mb anomalies near the dateline and 30°N. Another area of +4 to +5 anomalies extended across the western Bering Sea and northwest Pacific with a high pressure region centered over the Sea of Okhotsk. The Aleutian Low, or what was left of it, stood its ground over the Alaskan Peninsula. The steering currents (700 mb) showed a gentle cyclonic curvature. In an ideal situation a storm from Tokyo would end up over Vancouver Is.

On This Date— June 25, 1960 — Typhoon Olive, generating 125-kn winds, clobbered the central Philippines. Legaspi recorded winds of 100 kn. More than 600 people either died or were reported missing. Damage was widespread and several large ships sank.

Extratropical Cyclones— As might be expected given the strength of the subtropical high and ofter climatic features, storm activity was relatively light in June.

❶ The month opened with a bang. A storm that formed at the end of May really got it together in June. At 1200 on the 1st its 972-mb center was crossing the 45th parallel near 162°W, heading east northeastward. Ships were reporting winds in the 40- to 50-kn range in 10-to 20-ft seas. The ***Neptune Garnet*** (43°N, 161°W), at 0000 on the 1st, hit 50-kn southeasterlies. At 1800 the ***President Polk***, nearly 400 mi southeast of the center, hit a 46-kn south southeast wind in 21-ft

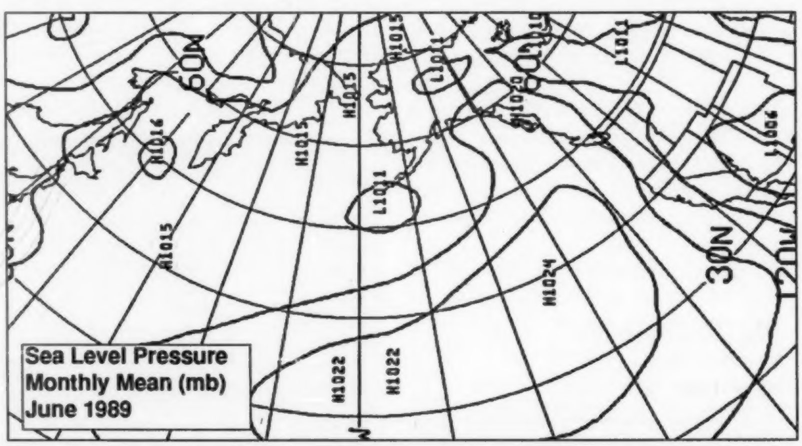


Figure 5.— The subtropical high once again in June made its presence felt across most of the North Pacific. This is a sign that conditions overall were good for the mariner.

seas. By this time the storm was turning northward and weakening somewhat. However, near storm force wind reports continued to pour in on the 2d from vessels that included the ***President Polk, Brazilian Sky, Marif and Harmac Dawn.*** Seas range from 10 to 23 ft. Late in the day as the system neared the 50th parallel winds in the 40–to 50–kn range were the rule. The weakening storm moved across the Alaskan Peninsula on the 4th.

❷ Another storm that was just barely worthy of mention developed on the 15th as a weak atmospheric wave, along a stationary front, near 30°N, 155°E. Moving northeastward it developed slowly. By the 17th it had formed a recognizable circulation and ships were reporting 30–to 35–kn winds around its center. Swells to the south were running 8 to 10 ft. By 1200 on the 18th, central pressure was down to 984 mb as the center approached the 50th parallel and turned toward the east northeast. The ***Tokyo Senator*** (41°N, 179°E), at this time, reported 43–kn westerlies in swells of 10 ft, while the ***Nemirov***, within 300 mi of the center, hit winds estimated at 61 kn from the northwest. The ***Tokyo Senator*** continued encountering gales into the 19th. The system was beginning to weaken as central pressure rose to 992 mb on the 19th. The following day it was barely recognizable, having been replaced by a short–lived system from the west.

Tropical Cyclones— The preliminary summaries of eastern North Pacific tropical cyclones were provided by the National Hurricane Center. Those in the west were summarized by the Hong Kong Royal Observatory.

Adolph was the first Eastern Pacific tropical cyclone to be tracked during 1989. A weak low–level circulation was detected, on visible satellite imagery, on May 29, about 500 mi south southwest of Acapulco, Mexico. The circulation was not detectable the following day, but the system redeveloped on the 31st and was estimated to have reached tropical storm status at 0600 on July 1.

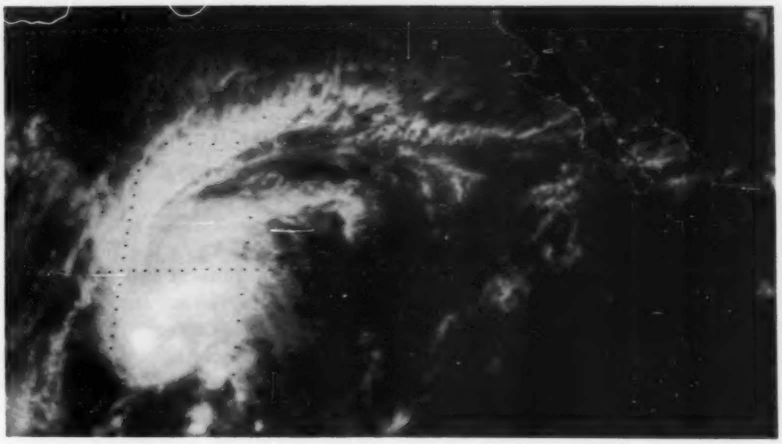


Figure 6.— Tropical Storm Adolph can be seen just after 0000 on the 4th, just as it was slowing and turning westward.

Adolph moved toward the west northwest at 10 to 15 kn from its inception until the 4th when its forward speed slowed to 5 kn and its heading changed to just south of due west (fig 6). This change in heading occurred as the deep convection was sheared northward by a strong upper–level flow and the low–level circulation moved westward under the steering of a shallow but persistent high pressure ridge to the north of the storm. The low–level circulation continued slowly westward and dissipated on the 5th.

The maximum 1–min wind speed estimate during Adolph's existence was 55 kn on June 2 and the corresponding minimum sea–level pressure estimate was 994 mb. Adolph did not affect land.

The tropical wave that became the seedling for Hurricane Barbara was first detected over southern Nigeria on May 24. The fifth identifiable tropical wave of the 1989 hurricane season made an uneventful trip across the Atlantic and arrived in the Lesser Antilles on June 4. After moving through the Caribbean, the wave slowed its forward speed on June 10, while located southwest of Acapulco, Mexico. During the next 3 days, the wave drifted slowly westward to a position near longitude 107°W by midday on the 13th. At 1800 the Tropical Satellite Analysis and Forecast (TSAF) unit of the National Hurricane Center (NHC) indicated the system was too weak to classify. Twenty–four hours later, on the 14th, TSAF meteorologists classified the system with a C.I. number of 1.5 on the Dvorak scale. This weak system persisted for the next 24 hours, and the NHC issued the first tropical depression advisory on Tropical Depression Number Two–E on the afternoon of the 15th. The depression became better organized and began to drift toward the north northeast in the wake of a well–defined frontal trough in the westerlies. By the 17th high pressure building over the southwestern United States and northern Mexico began to drive the budding storm toward the northwest.

Based upon satellite imagery, Tropical Depression Two–E was upgraded to Tropical Storm Barbara on the afternoon of the 16th. During the next 36 hr high pressure remained intact over the southwestern United States and northern Mexico, outflow at 200 millibars remained favorable, and the ocean water temperature remained near 28°C. As a result, the storm continued to strengthen as it moved toward the northwest at a forward speed of just under 10 knots. Based on satellite imagery, Barbara was upgraded to a hurricane at 0000 June 18.

First visible satellite pictures on the morning of the 18th indicated that stratocumulus clouds located over the

cooler waters to the immediate north and west of Barbara were beginning to be advected into the circulation of the hurricane. Later that day the center of Barbara crossed the 26°C isotherm and the hurricane weakened to storm strength by 0000 on the 19th. Almost all of the deep convection was sheared off during the following 24 hours and, by 0000 on the 20th, all that remained of the former steering currents turned the depression toward the west. Barbara was officially terminated on the evening of the 21st.

The third tropical depression of 1989 in the Eastern Pacific formed several hundred miles to the south of Acapulco, Mexico on June 19th. It was associated with a tropical wave traced back to the northwest coast of Africa approximately 2 weeks prior to that date. On the 17th and 18th several different centers of circulation were observed on satellite pictures before a single center organized. On the basis of satellite and synoptic ship reports NHC upgraded the system to Tropical Depression Three-E during the afternoon of the 18th. The depression was designated Tropical Storm Cosme on the morning of the 20th. Cosme attained hurricane strength the following morning.

From the 19th to the 20th Cosme remained nearly stationary as the circulation gradually organized. After attaining hurricane status it turned toward the north with increasing forward speed. The center moved onshore just east of Acapulco the night of the 21st. After moving inland and rapidly weakening, the remnants of Cosme continued to accelerate northward through eastern Mexico. The circulation was last identified, on satellite pictures, as a swirl in the clouds south of Brownsville, TX on the 23d. The development of Tropical Storm Allison in the northwest Gulf of Mexico can be partially attributed to the pressure and wind patterns associated with Cosme.

Based upon satellite estimates, maximum sustained winds in Cosme were around 75 kn and the lowest sea level pressure of 979 mb occurred prior to landfall. The highest recorded wind in Acapulco was 30 kn with gusts to 40 kn. Winds gusting to 50 kn were reported at Puerto Escondido, Mexico, located about 150 mi east of where Cosme made landfall. The maximum wind from a ship was 55 kn reported by the ***Keystoner*** just east of the center at 2200 on June 21. Other ship wind reports were 45 kn by the ***Toyofuji No. 10*** at 1800 on June 21 and 40 kn by the ***Maasolot*** at 0600 on the 20th, both just northeast of center.

Very heavy rains accompanied the hurricane over southern Mexico with reports of flash floods an mudslides over coastal mountains. Rainfall amounts in excess of 5 in during a 12 hr period were recorded along the coast at Acapulco during the night of June 21st.

The Mexican government reported at least 30 deaths due to drowning. Many adobe houses were destroyed by floods. No estimate of dollar damage is available at this time.

Dot developed as a tropical depression about 540 mi southeast of Manila on the afternoon of the 5th, moving west northwestward at about 10 kn, toward the Philippines. It intensified into a tropical storm the next morning and then rapidly crossed the central Philippines . Upon entering the South China Sea on the morning of the 7th, Dot turned northwestward. Early on the 8th, it slowed while curving toward the west northwest and intensified to a severe tropical storm. Dot reached typhoon intensity when it was about 300 mi east southeast of Xisha on the afternoon of the 8th (fig 7). The center of Dot passed about 16 mi north northeast of Xisha the following afternoon. Dot traversed southern Hainan on the morning of the 10th and weakened to a severe tropical storm. When the storm entered BeibuWan that evening, it turned north northwestward. It finally made landfall as a tropical storm over northern Vietnam near Haiphong on the afternoon of the 11th. Over land, Dot moved northwestward and dissipated about 40 mi northeast of Hanoi that evening.

Figure 7.— Typhoon Dot poses at 1800 on the 8th.

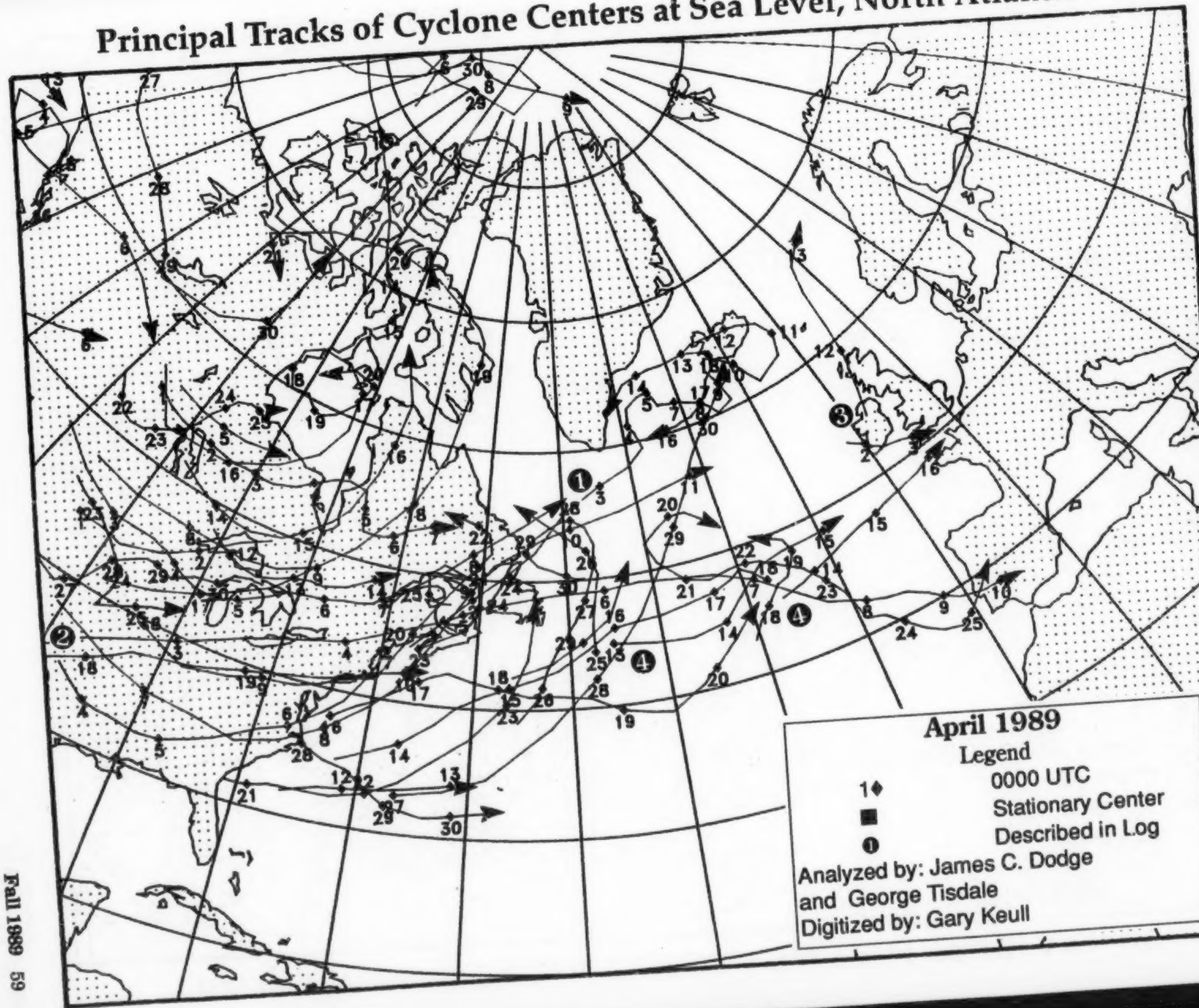
According to press reports, at least two people were killed and one was reported missing in Hainan Province. About 1,400 houses collapsed and 60,000 houses were damaged. Torrential rain brought damage to almost 50,000 hectares of crops.

The coastal regions of Guangxi were also affected by gale force winds and heavy rain. Over 300 houses collapsed and eight people were injured. More than 1,000 hectares of corn and sugar-cane were affected. However, heavy rain also eased the drought situation of Guangxi. In Vietnam three people were killed. About 7,00 hectares of rice fields and 34,000 hectares of the winter-spring crops were flooded. Hanoi was flooded by torrential rain and electricity was cut off. Haiphong also suffered widespread property damage.

Tropical Depression Ellis formed over the Pacific about 450 mi south of Okinawa on the evening of June 22. It moved west northwestward, initially, but turned to northeast early next day while intensifying to a tropical storm. Ellis then moved north northeastward at a speed of 25 kn, it became extratropical on the afternoon of June 23.

Casualties.— See Typhoon Dot and Hurricane Cosme for the only reported casualties this month.

Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



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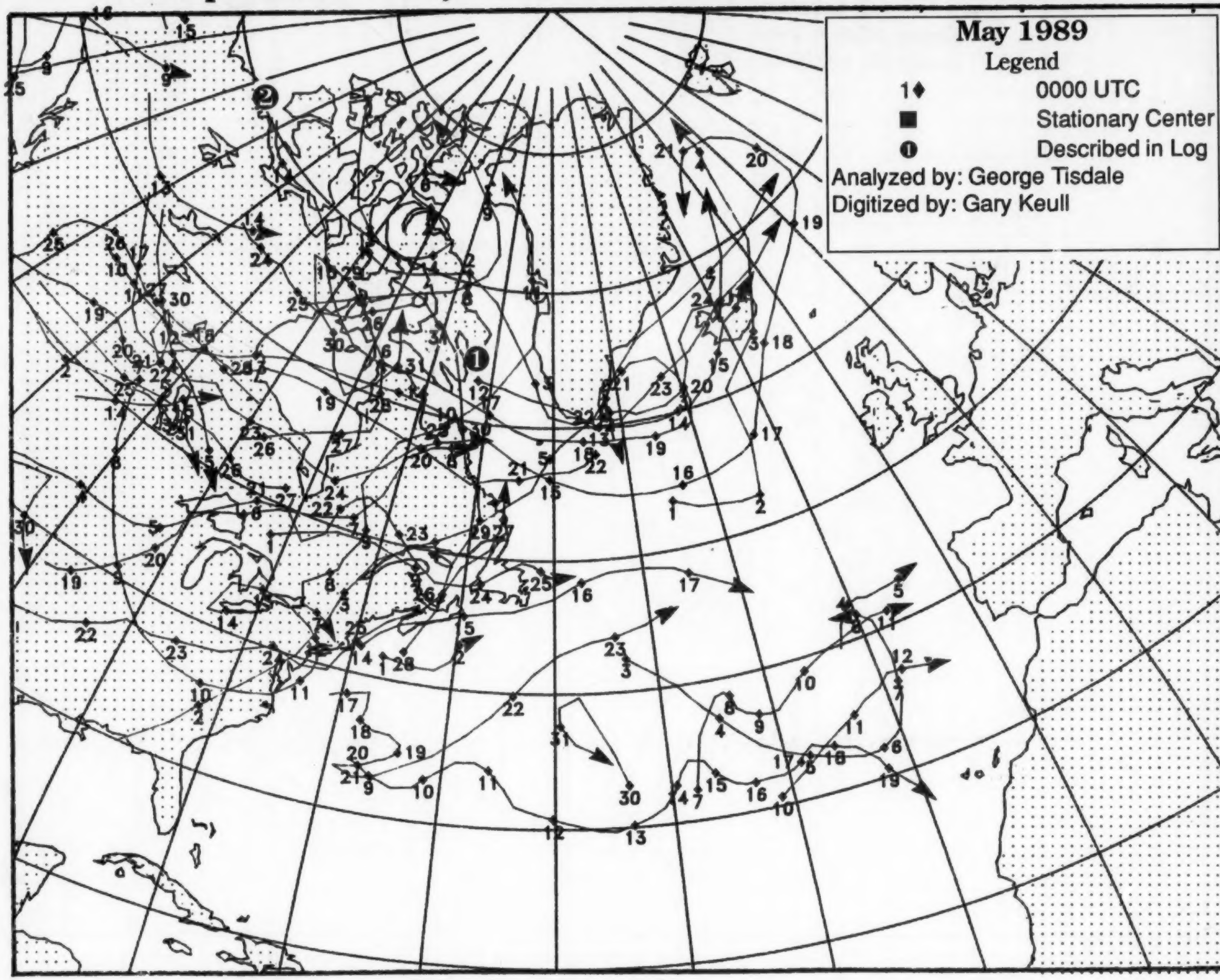

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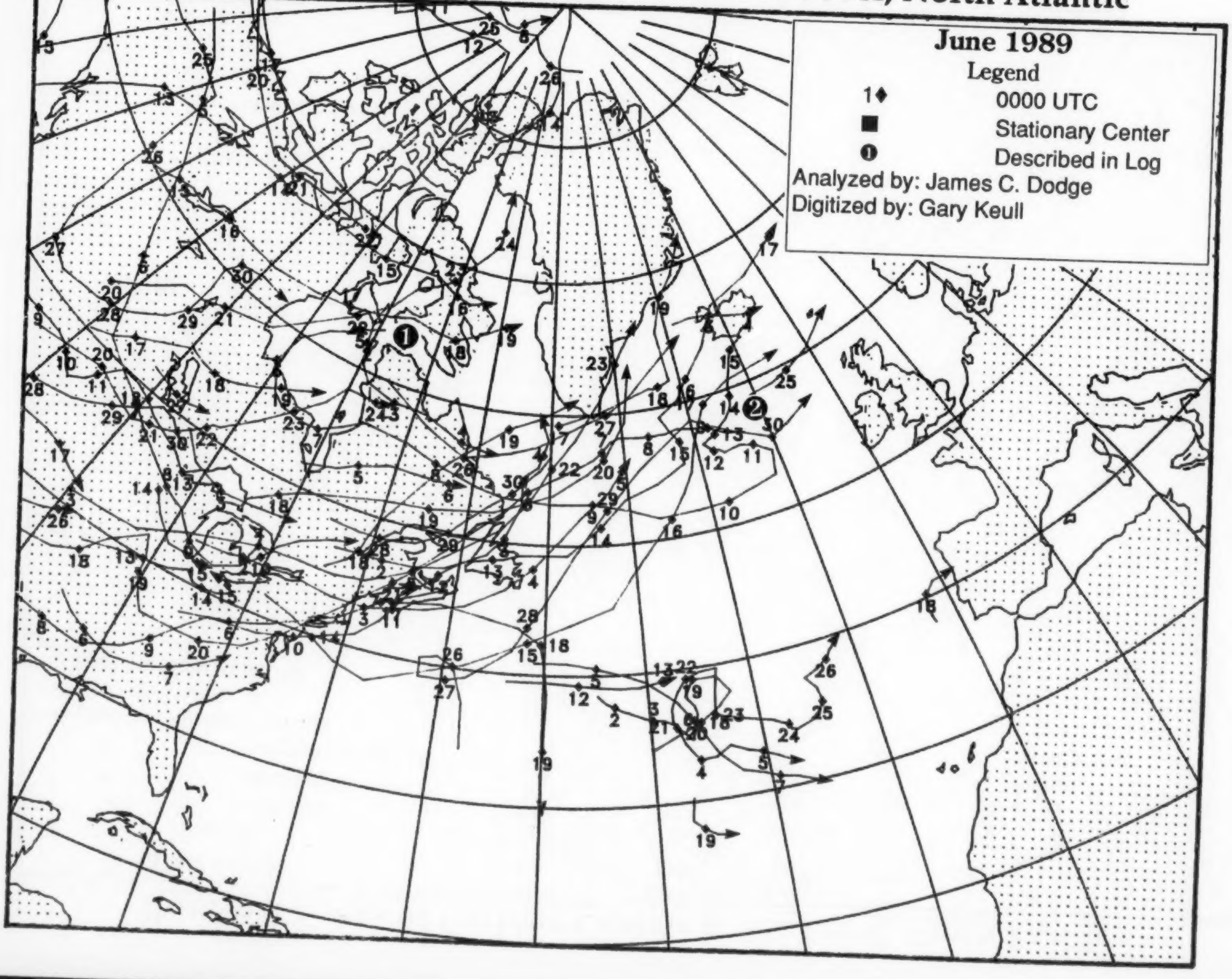
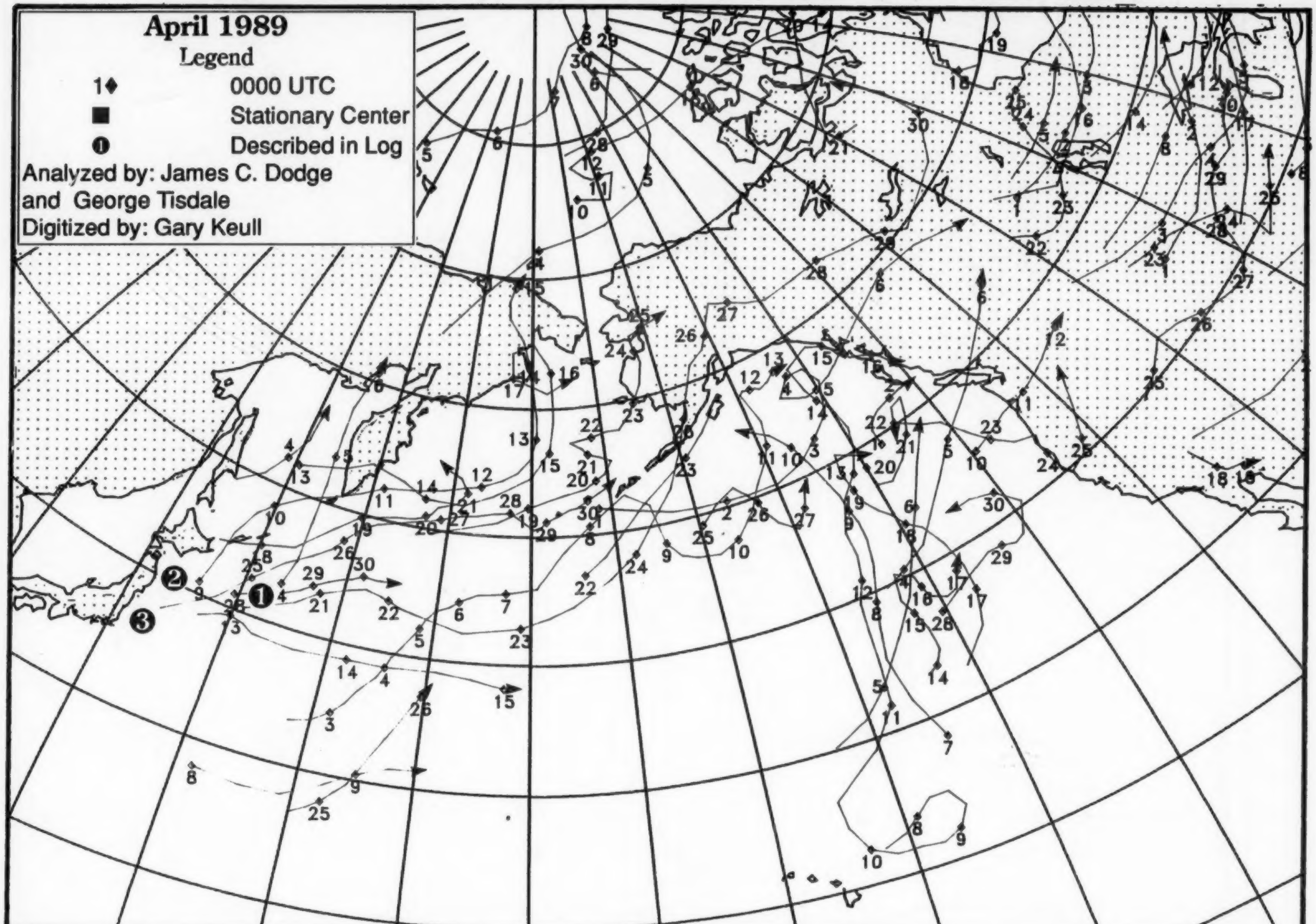


Principal Tracks of Cyclone Centers at Sea Level, North Pacific



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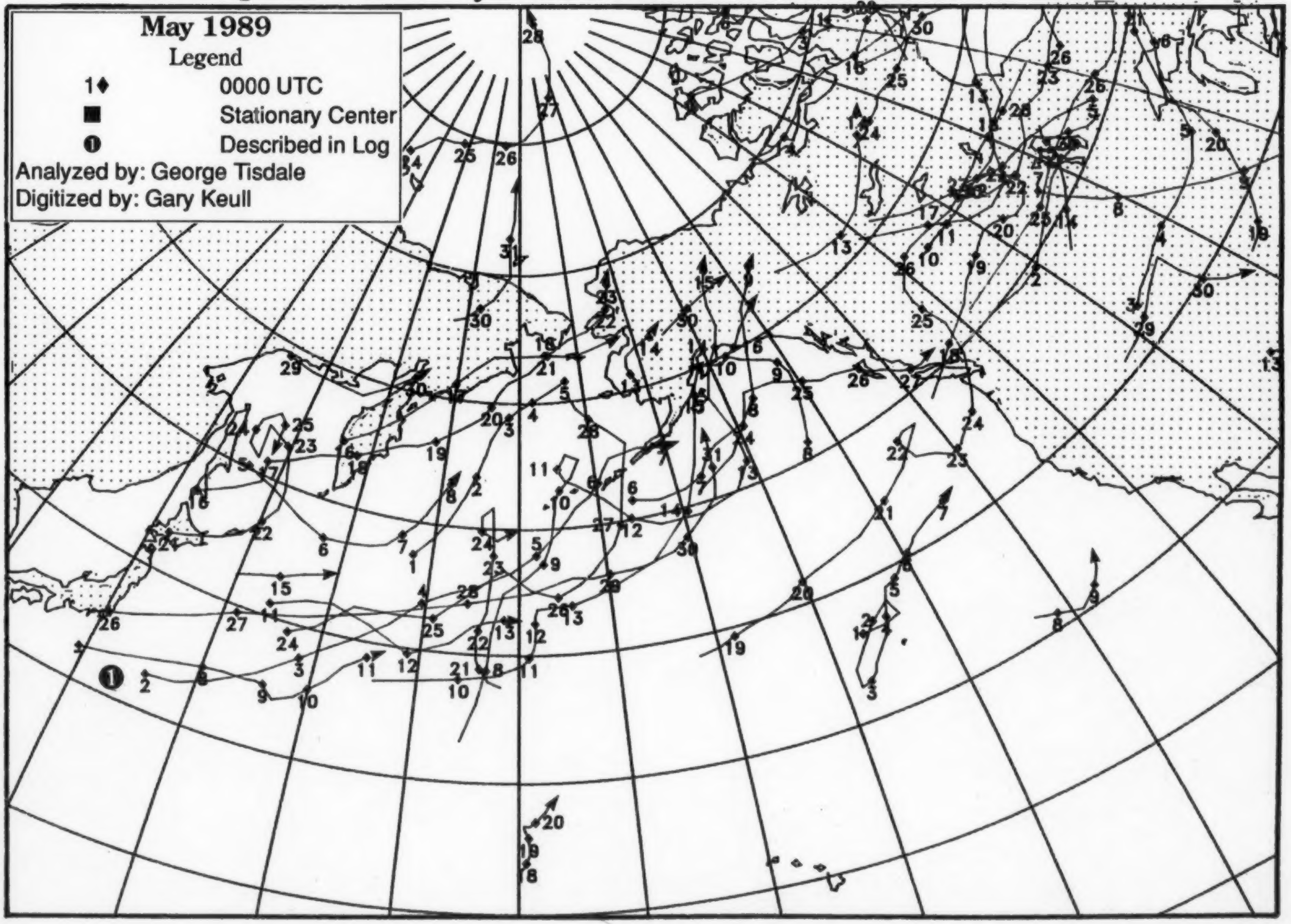

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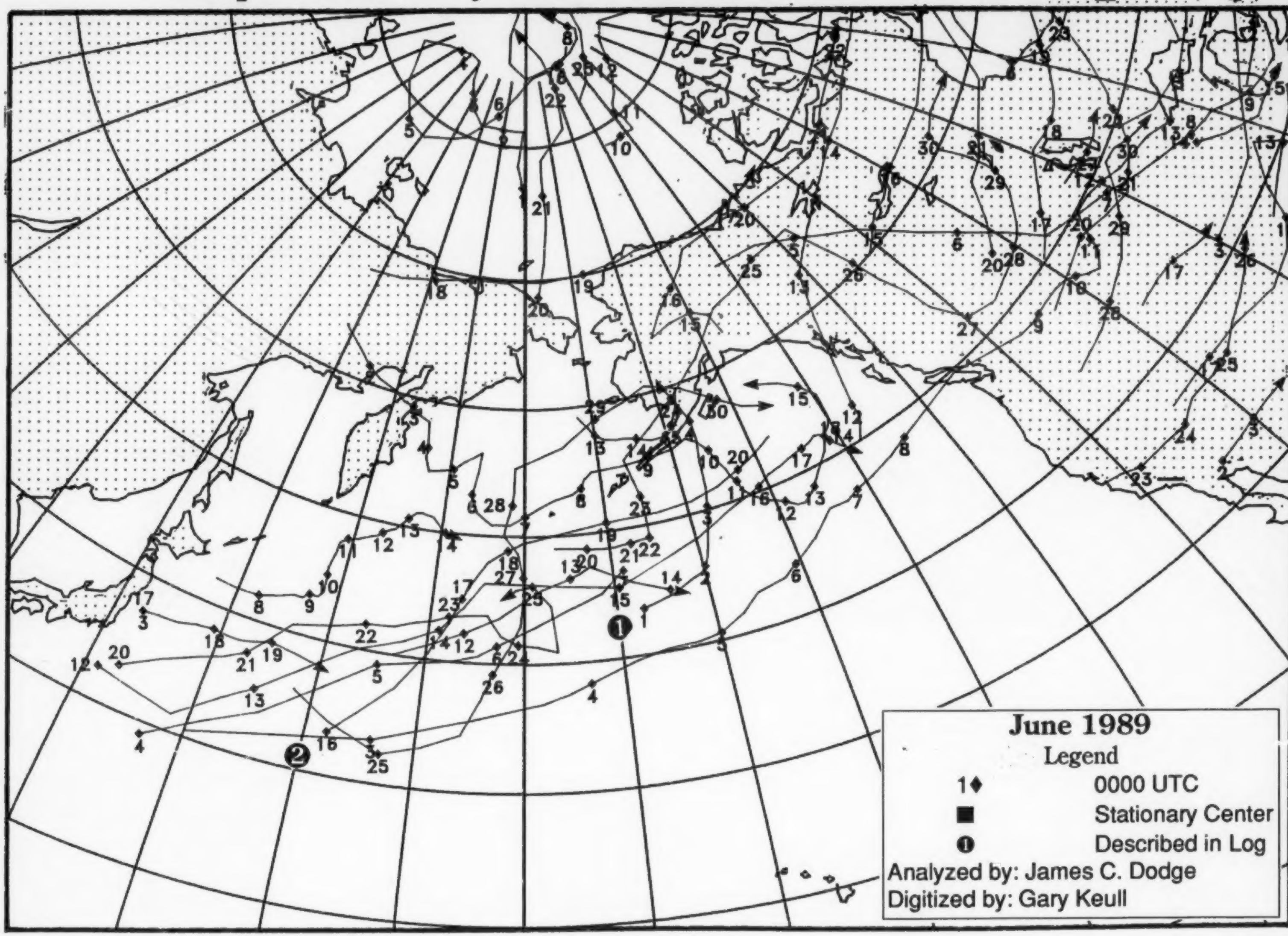

April, May and June 1989

Vessel	Ship Call	Date	Position Lat °	Position Long °	Hr UTC	Wind Dir 10°	Wind Speed Kn	Vsby	Pres Wx Code	Pressure Mb	Temp °C Air	Temp °C Sea	Sea Waves Pd sec	Sea Waves Hgt ft	Swell Waves Dir	Swell Waves Pd sec	Swell Waves Hgt ft
Pacific Apr																	
ORIENTAL PATRIOT	BMDH	1	43.2 N	149.4 E	06	15	M 52	.5 NM	45	1010.0	7.0	1.0	12	16.5	15	12	19.5
ORIENTAL PATRIOT	BMDH	1	41.9 N	147.9 E	12	15	M 48	.5 NM	45	1001.5	8.0	1.0	12	16.5	15	12	19.5
BACTAZAR	DUHJ	2	43.6 N	151.7 E	00	17	M 44	.5 NM	95	1001.0	6.0	6.0	12	19.5	16	14	19.5
SEA ACE	3EXT4	2	48.5 N	133.2 W	06	27	M 44			0994.0	6.0	7.3	10	10	27	14	21
AQUA GARDEN	C6BD9	2	32.7 N	159.5 E	12	15	M 47	.5 NM	63	1008.3	17.0	17.0	8	24.5	13	9	24.5
SEALAND PATRIOT	KHRF	4	42.7 N	169.6 E	00	12	M 42	2 NM	61	1024.8	9.0		8	16.5	13	11	24.5
SEALAND DEVELOPER	KHRH	4	47.0 N	164.6 E	06	14	M 41			1018.2	5.0	5.0	7	24.5	14	7	24.5
SEALAND DEVELOPER	KHRH	4	47.7 N	166.9 E	12	14	M 43			1013.0	3.0	2.0	6	8	14	8	32.5
PRESIDENT JACKSON	WRYC	4	43.8 N	170.6 E	18	15	M 45	5 NM	10	1013.5	6.8	4.1	4	10	15	10	19.5
NEPTUNE PEARL	S6GY	7	44.6 N	179.0 W	00	17	M 50	.5 NM	10	1021.0	9.0	5.0	7	19.5	20	9	23
PRESIDENT F. ROOSEVELT	KRJF	11	39.5 N	146.2 W	18	14	40	.5 NM	63	1008.0	12.8	12.2	6	19.5	12	10	18
PRESIDENT ADAMS	WRYW	12	54.5 N	172.8 W	18	17	M 45	2 NM	53	0986.0	4.0	2.4	8	11.5	17	10	24.5
PRESIDENT ADAMS	WRYW	13	54.1 N	179.9 W	06	28	M 40	5 NM	88	0987.0	3.0	2.3	8	11.5	28	12	19.5
PRESIDENT ADAMS	WRYW	14	52.7 N	170.9 E	00	22	M 47	5 NM	02	0985.0	4.0	2.8	4	6.5	23	6	23
COASTAL STAR	WUU9229	15	57.2 N	170.2 W	18	27	M 45	.5 NM	86	0999.5	- 0.5	0.6	4	10	27	10	26
PRESIDENT MADISON	WCIP	16	50.1 N	174.5 E	00	22	50	5 NM		1013.9	3.3	1.7	6	10	24	9	24.5
ACE ACCORD	DULU	16	51.0 N	176.5 E	12	26	M 50	2 NM	28	1015.0	3.0	6.0	18	28	25	19	29.5
POQUITA MAMI	DUZB	16	39.7 N	139.4 E	18	17	M 52	2 NM		0989.0	9.0	12.0	13	19.5	17	16	23
COASTAL STAR	WUU9229	16	57.3 N	170.1 W	18	22	M 45	.5 NM	86	0997.0	1.0	0.6	2	8	18	10	26
ACE ACCORD	DULU	17	50.8 N	174.7 E	00	27	M 40	10 NM		1023.0	6.0	6.0	12	18	27	14	21
EVER SUMMIT	BKHU	18	44.2 N	157.6 E	18	25	M 42	1 NM	53	0996.0	4.0	5.0	7	32.5	22	11	39
LUZON	3ESJ3	25	44.4 N	149.0 E	18	33	M 55	.5 NM		0990.0	0.0	2.0	10	19.5	05	7	18
HANJIN BUSAN	D7EN	25	41.1 N	150.0 E	23	29	M 44	5 NM	00	1007.0	5.0	- 2.0	5	6.5	29	10	24.5
STAR ESPERANZA	DVFP	26	37.7 N	156.1 E	00	27	M 44			1010.0	11.0	14.0	9	19.5	27	9	19.5
WESTWOOD MARIANNE	DUPU	26	41.8 N	168.3 E	06	25	M 50	1 NM	18	1003.0	13.0	12.0	12	31	25	12	31
ACE ENTERPRISE	DJUC	26	52.5 N	162.7 E	12	05	M 47	1 NM	83	0982.5	0.0	2.0	10	19.5	09	9	10
EVER SUMMIT	BKHU	26	41.9 N	153.9 E	18	29	M 40			1015.0	2.0	4.0	6	16.5	29	8	29.5
ACE ENTERPRISE	DJUC	26	52.4 N	161.3 E	18	03	M 48	.5 NM	83	0980.5	0.0	2.0	10	19.5	09	9	19.5
WESTWOOD MARIANNE	DUPU	26	41.5 N	166.7 E	18	25	M 55	1 NM	18	1005.0	8.0	10.0	12	41	25	14	41
WESTWOOD MARIANNE	DUPU	27	40.8 N	165.6 E	06	28	M 45	200 YD	18	1014.0	8.0	11.0	12	39	28	14	41
WESTWOOD MARIANNE	DUPU	27	40.6 N	163.9 E	18	29	M 49	5 NM		1019.0	7.0	11.0	10	32.5	29	10	32.5
COASTAL STAR	WUU9229	27	58.1 N	171.1 W	18	13	M 50	5 NM	02	1009.0	1.0	1.0	0	6.5	13	10	19.5
COASTAL STAR	WUU9229	28	58.9 N	171.7 W	00	09	M 55			1010.2	0.0	1.0	6	19.5	09	10	19.5
COASTAL STAR	WUU9229	28	59.7 N	172.3 W	06	07	M 50	5 NM	02	1011.0	- 2.0	1.0	6	19.5	07	10	19.5
COASTAL STAR	WUU9229	28	60.3 N	173.1 W	12	03	M 50			1010.5	- 3.0	1.0	6	10	04	10	19.5
WESTWOOD MARIANNE	DUPU	29	38.5 N	156.9 E	00	26	M 42	2 NM	07	0996.0	9.0	10.0	10	24.5	26	10	24.5
ORIENTAL FRIENDSHIP	ELFV3	29	39.0 N	149.0 E	00	32	41			1006.5	6.0	10.0	12	16.5	31	10	19.5
PRESIDENT MONROE	WNRD	29	40.0 N	144.7 W	00	30	M 40	10 NM		1011.0	11.1	11.7	4	16.5	34	8	26
WESTWOOD MARIANNE	DUPU	29	38.4 N	156.6 E	06	25	M 40	2 NM	19	1000.0	9.0	10.0	12	36	25	12	36
PRESIDENT TRUMAN	WNDP	29	35.7 N	157.8 E	12	24	M 40	5 NM		1005.0	14.5	13.2	6	23	24	11	32.5
Atlantic Apr																	
SAMOAN REEFER	OXHH3	1	37.2 N	71.4 W	18	28	40	5 NM	02	1012.5	12.0		8	19.5			
CHERRY VALLEY	WIBK	1	47.3 N	12.8 W	18	27	40	10 NM		1010.0	8.3	9.4	8	23	27	14	26
CHERRY VALLEY	WIBK	2	45.5 N	18.1 W	12	33	46	10 NM	29	1016.4	7.2	10.0	8	19.5	33	12	26
CHERRY VALLEY	WIBK	2	43.9 N	18.5 W	18	33	47	10 NM	18	1016.9	10.0	10.0	8	19.5	33	14	26
CHERRY VALLEY	WIBK	3	42.9 N	19.8 W	00	34	45	10 NM		1018.4	8.3	10.5	8	19.5	34	14	23
MORMACSUN	WMBK	8	45.3 N	15.2 W	06	09	45	5 NM	81	0996.2	11.3	11.7	4	14.5	11	8	19.5
MORMACSKY	WMBQ	8	34.8 N	70.7 W	12	28	40	5 NM		1011.5	14.4	19.4	5	14.5	30	9	24.5
CHERRY VALLEY	WIBK	8	37.2 N	60.2 W	18	20	40	10 NM		1014.1	20.0	17.2	8	23	24	9	26
CHERRY VALLEY	WIBK	10	37.7 N	65.2 W	00	27	40	10 NM	02	1016.2	17.2	16.7	7	14.5	25	10	29.5
RAINBOW HOPE	KNDB	11	49.4 N	36.8 W	06	30	40	5 NM	81	1004.0	6.7		4	13	29	10	32.5
MSC SABRINA	IBPA	16	47.1 N	15.5 W	00	33	50			1023.0	9.0		10	19.5			
SHELDON LYKES	KRJP	16	36.7 N	72.9 W	00	14	40	2 NM	25	1017.0	17.8	22.8	5	18	14	7	21
DELAWARE BAY	WMLG	16	41.8 N	42.6 W	12	28	M 40	2 NM		1011.2	11.0		8	10	28	12	19.5
USNS HENRY J. KAISER	NHJK	16	46.3 N	07.2 W	18	29	M 40	5 NM	02	1012.0	8.8	11.6	5	11.5	32	12	19.5
RAINBOW HOPE	KNDB	17	41.9 N	61.5 W	18	30	45	2 NM	58	1001.2	9.4		4	10	25	10	24.5
RALEIGH BAY	KRNG	17	39.3 N	61.9 W	18	29	M 40	2 NM		1010.0	16.0		3	13	27	8	19.5
MSC SABRINA	IBPA	18	43.3 N	32.4 W	00	32	45			1007.0	12.0	15.0	10	16.5	30	15	23
EXPORT PATRIOT	WCJY	24	36.5 N	20.7 W	12	35	45	5 NM	18	1008.5	16.1	17.2	6	6.5	34	12	26
WINTER WAVE	S6BA	25	37.8 N	11.5 W	18	36	40	5 NM		1010.0	13.0	15.5	3	10	34	6	29.5
CHESAPEAKE BAY	WMLH	28	45.6 N	34.1 W	18	21	M 48	2 NM	11	1013.0	14.4		2	10	20	4	19.5

Selected Gale and Wave Observations

Vessel	Ship Call	Date	Position Lat °	Position Long °	Hr UTC	Wind Dir 10°	Wind Speed Kn	Vsby	Pres Wx Code	Pressure Mb	Temp °C Air	Temp °C Sea	Sea Waves Pd sec	Sea Waves Hgt ft	Swell Waves Dir	Swell Waves Pd sec	Swell Waves Hgt ft
				Pacific May													
GREEN BAY	KGTH	2	33.0 N	164.7 E	18	15	M 52	1 NM	65	1012.0	16.5	15.0	8	13	13	10	23
OCEAN STEELHEAD	H3VD	3	37.4 N	165.4 E	00	13	M 45	.25 NM		1007.5	16.0	14.0	12	19.5	15	14	19.5
OCEAN STEELHEAD	H3VD	3	37.8 N	163.7 E	06	15	M 62	200 YD		1007.5	15.5	14.0	12	19.5	15	14	19.5
OREGON RAINBOW II	3EKN3	3	39.4 N	158.5 E	12	32	M 45	200 YD	50	0998.0	8.5	13.0	6	26	32	13	34.5
OCEAN STEELHEAD	H3VD	3	37.9 N	163.7 E	12	24	M 50	200 YD	45	0987.0	13.0	12.0	12	19.5	23	14	18
DIANA	VJWN2	7	43.1 N	176.6 W	23	12	M 41	50 YD	63	1000.0	10.0	9.0	9	19.5	14	6	18
CYPRESS PASS	ELNT6	8	42.0 N	174.7 W	00	13	M 40	.5 NM	55	1005.0	11.0	10.0	6	19.5	14	7	16.5
GREEN LAKE	KGTI	8	44.4 N	174.6 W	05	13	M 57	1 NM		0998.5	9.0		10	29.5	13	15	39
USNS SEALIFT PACIFIC	NENC	8	42.1 N	172.0 E	06	31	40	5 NM	50	1005.2	4.5		11	19.5			
PRESIDENT MADISON	WCIP	8	46.0 N	175.9 W	06	11	40	.5 NM	62	0993.2	6.1	3.9	10	19.5	12	14	23
COASTAL STAR	WUU9229	10	58.2 N	169.9 W	00	09	M 50	10 NM	01	1010.3	2.0	- 1.0	3	10	10	8	19.5
COASTAL STAR	WUU9229	10	57.7 N	169.5 W	06	09	M 50	10 NM	03	1007.5	3.0	- 1.0	3	8	09	8	24.5
ARCO SAG RIVER	WLDF	11	40.5 N	125.5 W	18	02	M 48	10 NM		1020.0	15.6	10.6	4	10	01	9	21
				Atlantic May													
NUAL ANGELITA	DULT	10	42.5 N	38.6 W	12	05	M 41	10 NM		1022.0		15.0	9	23	05	11	23
				Pacific June													
PRESIDENT POLK	WAVD	1	44.3 N	159.7 W	00	15	M 46	5 NM	61	0998.8	8.5	8.7	6	21	14	10	16.5
PRESIDENT POLK	WAVD	1	44.1 N	156.6 W	06	14	M 40	5 NM	61	0998.5	9.6	8.6	6	21	14	10	19.5
FAIRWIND EXPRESS	DZEZ	2	46.7 N	166.8 W	06	36	M 40	.25 NM	41	0997.0	6.0	8.0	14	23	35	14	23
PRESIDENT POLK	WAVD	2	42.5 N	145.2 W	06	16	M 40	2 NM	61	1017.5	14.8	11.3	10	21	18	12	29.5
SEALAND VOYAGER	KHRK	18	39.0 N	147.7 E	00	06	50	1 NM	65	0999.8	15.6	20.0	7	10	07	14	24.5
EVER GENERAL	BKHY	23	39.5 N	173.9 W	00	26	M 45			0995.0	13.0	12.0	8	19.5	25	11	28
				Atlantic June													
LOUISIANA BRIMSTONE	KQTM	9	28.3 N	86.6 W	00	20	40			1011.2	28.9	28.9	6	16.5	18	9	24.5

January, February and March 1989

Ship Name	radio	mail
1ST LT ALEX BONNYMAN	39	
1ST LT JACK LUMMIS	27	31
2ND LT. JOHN P. BOBO	16	17
A. V. KASTNER	132	
ABBEY	129	
ACADIA FOREST	87	58
ACE ACCORD	109	70
ACE ENTERPRISE	39	76
ACONCAGUA	21	31
ACT 11	32	
ACT 111	185	
ACT 12	95	
ACT 5	140	
ACT 6	121	
ACT 7	169	
ACT 9	75	
ACT I	75	
ACT IV	151	
ADABELLE LYKES	52	46
ADDIRIYAH	66	68
ADMIRALTY BAY	36	119
ADONIS	12	
ADRIAN MAERSK	16	27
AFRICAN FERN	70	90
ALAIN LD	97	
ALASKA RAINBOW	16	16
ALBERT MAERSK	21	47
ALDEN W. CLAUSEN	26	107
ALEMANIA EXPRESS	48	
ALLIGATOR FORTUNE	30	47
ALLIGATOR GLORY	33	
ALLIGATOR HOPE	60	135
ALLIGATOR LIBERTY	64	
ALLIGATOR TRIUMPH	69	134
ALMERIA LYKES	49	67
ALPHA HELIX		60
ALTAMONTE	45	41
ALVA MAERSK	22	
AMADEUS	2	
AMBASSADOR	44	95
AMBASSADOR BRIDGE	70	39
AMERICA EXPRESS	79	
AMERICA SUN	24	5
AMERICAN ALABAMA	51	133
AMERICAN CONDOR	20	21
AMERICAN CORMORANT	44	
AMERICAN EAGLE	57	54
AMERICAN FALCON	47	112
AMERICAN KESTREL		33
AMERICAN MAINE	73	135
AMERICAN REPUBLIC	50	108
AMERICAN RESOLUTE	39	101
AMERICAN UTAH	55	150
AMERICAN VIRGINIA	61	135
ANDERS MAERSK	69	145
ANTHONY RAINBOW	58	127
AQUA CITY	65	164
AQUA GARDEN	48	102
AQUARIUS	54	176
ARCO ALASKA	13	26
ARCO ANCHORAGE	29	14
ARCO CALIFORNIA	26	25
ARCO FAIRBANKS	13	19
ARCO JUNEAU	20	45
ARCO PRUDHOE BAY	20	
ARCO SAG RIVER	13	18
ARCO SPIRIT	11	3
ARCO TEXAS	25	35
ARCTIC TOKYO		131
ARGONAUT	44	86
ARGUS EXPLORER	19	
ARILD MAERSK	30	103
ARIOSTO AMADO	66	
ARMCO	138	228
ARNOLD MAERSK	76	166
ARTHUR M. ANDERSON	172	143
ARTUS		44
ASPEN	13	
ASTORIA	120	
ASTRO JYOJIN	5	20
ATIGUN PASS	53	203
ATLANTIC	57	73
ATLANTIC CARTIER	90	
ATLANTIC COMPANION	83	
ATLANTIC CONVEYOR	130	
ATLANTIC SPIRIT	30	55
AURORA ACE	96	
AUSTANGER	23	
AUSTRAL RAINBOW	30	70
B.T. SAN DIEGO	33	118
BAAB ULLAH	44	8
BACTAZAR	34	85
BADGER	14	105
BALTIMORE TRADER	14	2
BARRYDALE	168	
BATTERSEA	26	
BAY BRIDGE	131	
BCR KING	10	
BEACON	8	
BEBEOURO	32	
BEER SHEVA	3	
BELGIAN SENATOR	51	
BELLE RIVER	77	168
BENSON FORD	39	30
BHARATENDU	3	
BHAVABHUTI	1	
BIBI	107	
BISLIG BAY	9	
BLACKHAWK		65
BLUE HAWK	71	
BRIGIT MAERSK	34	103
BRILLIANT ACE	88	
BROOKLYN BRIDGE	119	
BROOKS RANGE	29	21
BUNGA KESIDANG	8	
BUNGA MELAWIS	1	
BUNGA TEMBUSU	1	150
BURNS HARBOR	122	212
CALANUS	15	20
CALCITE II	131	103
CALIFORNIA HERMES	37	25
CALIFORNIA VENUS	2	
CALIFORNIA ZEUS	45	
CALYPSO		46
CANADIAN RAINBOW	9	98
CAPE BYRON	67	
CAPE HENRY	42	
CAPE HORN	6	
CAPE YORK	166	
CAPRICORN	23	43
CARIBE I	5	45
CARLA A. HILLS		73
CARMEN	24	
CAROL	65	111
CAROLINA	55	139
CASON J. CALLAWAY	77	85
CATTLEYA ACE		83
CELEBRATION	14	32
CGM CALIFORNIA	58	64
CHABLIS	104	161
CHACO	22	
CHARLES M. BEEGHLEY	2	
CHARLES PIGOTT		24
CHARLOTTE LYKES	115	45
CHELSEA	5	13
CHEMBULK CLIPPER	7	
CHEMICAL PIONEER	40	18
CHERRY VALLEY	44	103
CHESAPEAKE BAY	49	171
CHESAPEAKE TRADER	40	73
CHESNUT HILL	20	46
CHEVRON ARIZONA	29	65
CHEVRON BURNABY	115	116
CHEVRON CALIFORNIA	114	120
CHEVRON COLORADO	2	17
CHEVRON EDINBURGH	42	200
CHEVRON EQUATOR	52	186
CHEVRON FELUY	6	41
CHEVRON LONDON		230
CHEVRON LOUISIANA		1
CHEVRON METEOR	36	37
CHEVRON MISSISSIPPI	68	148
CHEVRON NAGASAKI		180
CHEVRON OREGON	24	41
CHEVRON PACIFIC	118	234
CHEVRON STAR		294
CHEVRON SUN	2	
CHEVRON WASHINGTON	45	75
CHRISTINA	149	
C!TADEL HILL	25	
CLARENCE	62	
CLEMENT	71	
CLIPPER ALLIANCE		10
CO-OP EXPRESS II	47	
COAST RANGE	28	57
COASTAL MANATEE	42	9
COASTAL STAR		169
COLINA	49	67
COLUMBIA STAR	25	70
COLUMBUS AMERICA	331	
COLUMBUS AUSTRALIA	54	
COLUMBUS CANADA	5	
COLUMBUS ISELIN	48	
COLUMBUS LOUISANA	94	
COLUMBUS NEW ZEALAND	163	
COLUMBUS OHIO	14	
COLUMBUS QUEENSLAND	111	
COLUMBUS VICTORIA	131	
COLUMBUS VIRGINIA	149	
COLUMBUS WELLINGTON	171	
CONCERT EXPRESS	97	
CONTINENTAL HIGHWAY	26	
CORAH ANN	3	22
CORMORANT ARROW	7	
CORNUCOPIA	64	53
CORONADO	14	
CORWITH CRAMER	48	39
COURTNEY BURTON	121	164
CPL. LOUIS J. HAUGE JR	21	48
CRISPEN OGLEBAY	2	3
CYGNUS	1	8
CYPRESS PASS	11	41
CYPRESS TRAIL	20	
D.L. BOWER		214
DAMIOS DE GOIS	6	
DAVID PACKARD		36
DELAWARE BAY	42	92
DELAWARE TRADER	36	186
DIANA	3	33
DIRECT EAGLE	212	339
DOCK EXPRESS TEXAS	10	
DON JORGE	5	57
DUBHE	45	42
DUSSELDORF EXPRESS	94	
E.R. BRUSSEL	13	45
EASTERN FRIENDSHIP	33	139
EASTERN GLORY	34	59
EASTERN VENTURE	20	99
EDGAR B. SPEER	184	247
EDGAR M. QUEENY	13	48
EDWARD L. RYERSON	82	82
EDWIN H. GOTT	170	157
ELIZABETH LYKES	4	
EMERALD SEA	141	115
EMPIRE STATE	21	
ENDEAVOR	84	109
ENSOR	90	36
EVER GAINING	40	18
EVER GALLANT	3	
EVER GARDEN	3	7
EVER GENERAL		6
EVER GENTLE	10	6
EVER GIFTED	16	4
EVER GIVEN	11	
EVER GLAMOUR	15	6
EVER GLEAMY	8	
EVER GLEEFUL	10	22
EVER GLOBE	4	
EVER GLORY	21	
EVER GOING	7	
EVER GOLDEN	2	
EVER GOODS	8	
EVER GOVERN		11
EVER GRADE	4	
EVER GRAND	13	4
EVER GROUP	7	3
EVER GROWTH	5	13
EVER GUARD	32	31
EVER GUEST	1	
EVER GUIDE	14	15
EVER LAUREL	11	6
EVER LIVING	4	19
EVER LOADING	3	
EVER VITAL	5	
EXPEDITION		44
EXPORT FREEDOM	28	107
EXPORT PATRIOT	20	72
EXXON BALTIMORE	7	8
EXXON BATON ROUGE	22	20
EXXON BAYTOWN	3	5
EXXON BENICIA	8	
EXXON CHARLESTON	17	
EXXON LONG BEACH	6	5
EXXON NEW ORLEANS	3	2
EXXON NORTH SLOPE	17	21
EXXON PHILADELPHIA	23	26
EXXON PRINCETON	13	14
EXXON SAN FRANCISCO	16	24
EXXON YORKTOWN	25	38
FAIRWIND EXPRESS	40	27
FALCON CHAMPION	24	
FALCON LEADER	59	
FALCON PRINCESS	6	
FALSTRIA	27	
FARNELLA	49	
FAUST	19	22
FERNCROFT	83	140
FETISH	132	222
FIGARO	4	
FINNROSE	45	98
FLORIDA RAINBOW	51	117
FOREST SOVEREIGN	51	125
FORTALEZA	119	247
FRANCIS SINCERE NO. 6	42	
FRED A. WHITE	38	94
FREDERICKSBURG	23	22
GALVESTON BAY	67	153
GATEWAY EAST	64	165
GEMINI	58	132
GENERAL M.BELGRANDO	1	
GENEVIEVE LYKES	13	45
GEORGE A. SLOAN	173	129
GEORGE A. STINSON	110	256
GEORGE H. WEYERHAEUSER	13	47
GEORGE WASHINGTON BRID	199	
GEORGIA		94
GERMAN SENATOR	56	
GERONIMO	19	37
GLACIER BAY	49	98
GLOBAL WING	115	80
GLORIA	9	
GLORIOUS SPICA	33	
GLORITA	13	

Ship Name	radio	mail
GLORY FIELD	1	
GOLDEN APO	36	29
GOLDEN BLISS	16	
GOLDEN ENDEAVOR	14	32
GOLDEN GATE	5	
GOLDEN GATE BRIDGE	217	12
GOLDEN HILL	43	131
GRAIGLAS	162	
GREAT LAND	246	
GREEN ANGELES	6	28
GREEN BAY	119	229
GREEN ELLIOTT		39
GREEN HARBOUR	30	27
GREEN HAWK	10	
GREEN ISLAND	52	80
GREEN KOBE	13	28
GREEN LAKE	81	149
GREEN MASTER	6	56
GREEN MAYA	62	78
GREEN RAINIER	22	102
GREEN RIDGE	113	196
GREEN SAIKAI	1	30
GREEN SASEBO	53	157
GREEN STAR	28	116
GREEN VALLEY	11	
GREEN WAVE	60	95
GUANAJUATO	190	166
GUAYAMA	4	36
GULF IDEAL	53	
GULF SENTRY	47	82
GYPSUM BARON	122	
GYPSUM KING	285	
HAI JUNG	6	
HAKONE MARU	75	
HANEI PEARL	3	
HANEI SKY	30	113
HANEI SUN	58	52
HANJIN BUSAN	29	35
HANJIN CHEJU		29
HANJIN CHUNGMU	53	11
HANJIN HONG KONG	22	18
HANJIN KEELUNG	28	1
HANJIN KOBE	32	3
HANJIN KUNSAN	47	16
HANJIN KWANGYANG	37	3
HANJIN LONG BEACH	14	
HANJIN MOKPO	9	
HANJIN NEW YORK	14	32
HANJIN SAVANNAH	26	
HANJIN SEATTLE	36	
HANJIN SEOUL	50	
HANJIN YOKOHAMA	16	8
HANJIN YOSU	30	26
HANSA CARRIER	54	
HANSA STAR	18	32
HARMAC DAWN	81	
HASSAN MERCHANT	30	
HAWAIIAN RAINBOW	35	
HEERENGRASHT	114	
HEIDE	162	
HENRY HUDSON BRIDGE	202	
HENRY STEINBRENNER	50	98
HERBERT C. JACKSON	18	
HERMENIA	41	
HIRA #2	76	17
HOEGH CAIRN	10	
HOEGH CLIPPER	11	
HOEGH DENE	23	83
HOEGH DRAKE	31	43
HOEGH DYKE	52	
HOEGH MIRANDA	27	
HOHSING BREEZE	12	82
HOLIDAY	26	15
HOLSTEN CARRIER	27	51
HONESIA	92	208
HONOLULU	143	
HOWELL LYKES	43	101
HRELJIN	75	
HUAL ANGELITA	8	9
HUAL ROLITA	1	
HUAL TRANSPORTER	52	109
HUDSON TRADER	2	1
HUMACAO	72	162
HUMBER ARM	23	27
HYUNDAI #103	1	
HYUNDAI CHALLENGER	34	40
HYUNDAI COMMANDER	59	
HYUNDAI CONTINENTAL	36	
HYUNDAI EXPLORER	18	17
HYUNDAI INNOVATOR	9	
HYUNDAI ISLAND	55	
HYUNDAI NO. 107	23	12
HYUNDAI PIONEER	33	3
IBIS ARROW	32	
IMPERIAL	9	
INCOTRANS PACIFIC	56	
INFANTA	121	
INGER	101	219
IRENES EMERALD	1	
IRMA M	156	
IRVING L. CLYMER	135	167
ISLAND PRINCESS	93	
IST LT BALDOMERO LOPEZ	95	119
ITAITE	54	
ITAPE	19	
ITB PHILADELPHIA	177	210
J. BURTON AYERS	102	106
J.L. MAUTHE	51	100
JADRAN EXPRESS	27	
JALAGOVIND	1	
JALISCO	75	133
JAMES LYKES	2	9
JAMES R. BARKER	1	
JAPAN ALLIANCE	84	61
JAPAN APOLLO	131	109
JEAN LYKES	19	
JO BIRK	30	
JO CLIPPER	66	
JO CYPRESS	30	
JO GRAN	72	156
JO LONN	113	
JO OAK	62	
JOHN G. MUNSON	186	146
JOHN LYKES	36	40
JOSEPH H. FRANTZ	41	89
JOSEPH LYKES	21	27
JOVIAN LILY	70	149
JUBILEE	83	93
JULIUS HAMMER	56	79
KALIDAS	111	
KAUAI	55	208
KEBAN		29
KEISHO MARU	88	18
KENAI	5	5
KENNETH T. DERR	26	
KENT	43	181
KENTUCKY HIGHWAY	98	
KEYSTONE CANYON	6	43
KEYSTONER	48	133
KISO	128	
KITTANNING	5	28
KOKUA	8	209
KOLN EXPRESS	109	
KOPER EXPRESS	57	
KORYU MARU	12	
KOTA PETANI	57	75
KUROBE	78	
L.T. ARGOSY	64	61
LA PAMPA	16	
LARS MAERSK	6	2
LASH ATLANTICO	8	
LAURA MAERSK	26	65
LAURENCE H. GIANELLA	44	86
LEDA MAERSK	28	77
LEISE MAERSK	12	26
LEO TEMPEST	31	
LERMA	119	
LESLIE LYKES	7	
LETITIA LYKES	58	134
LEWIS WILSON FOY	181	361
LEXA MAERSK	24	61
LIBERTADOR GRAL SAN MA	6	
LIBERTY STAR	20	6
LIBERTY SUN	62	132
LIBERTY WAVE	45	
LICA MAERSK	28	34
LING LEO	55	169
LIONS GATE BRIDGE	24	72
LIRCAY	22	
LLOTD ITAJAI	64	
LLOYD SAO PAULO	109	
LLOYD VITORIA	46	
LNG TAURUS		46
LONG LINES	1	
LOTUS ACE	77	
LOUIS MAERSK	53	98
LOUISE LYKES	1	75
LOUISIANA BRIMSTONE	39	115
LT. ODYSSEY	6	
LURLINE	72	162
LUZON	40	129
LUZON SAMPAGUITA	42	12
LYRA	15	58
M. P. GRACE	14	
M/V MARINE RELIANCE	15	16
MACKINAC BRIDGE	237	79
MADAME BUTTERFLY	23	
MAERSK CONSTELLATION	70	28
MAERSK SUN	3	
MAERSK TACOMA	51	
MAERSK WIND	2	10
MAGALLANES	7	62
MAJ STEPHEN W PLESS MP	27	28
MALINI	53	36
MALLORY LYKES	66	126
MANGAL DESAI	15	
MANHATTAN BRIDGE	155	
MANILA PROSPERITY	12	
MANINGNING	42	114
MANUKAI	73	134
MANULANI	66	189
MANYAS-1	1	
MARATHA MAJESTY	12	21
MARCHEN MAERSK	22	65
MARGARET LYKES	101	60
MARGRETHE MAERSK	36	96
MARIA TOPIC	35	103
MARIF	24	14
MARIT MAERSK	35	62
MARITIME ASSOCIATE	52	62
MARJORIE LYKES	41	
MARLIN		40
MARY ANNE	10	
MASON LYKES	77	119
MATSONIA	69	223
MAUI	79	199
MAWASH TAPUK	18	
MAYAGUEZ	76	98
MEDALLION	131	171
MEDUSA CHALLENGER	32	105
MELBOURNE HIGHWAY	47	19
MELGAR BAY	16	136
MELVILLE	135	278
MERAK EIGHTY	47	131
MERCANDIAN CONTINENT	41	15
MERCANDIAN SUN II	69	200
MERCURY ACE	43	
MERIDA	89	162
MESABI MINER	203	322
METTE MAERSK	2	13
MICHIGAN	2	
MICHIGAN HIGHWAY	49	
MICRONESIAN COMMERCE	21	40
MICRONESIAN INDEPENDEN	116	120
MIDDLETOWN	2	
MINDORO SAMPAGUITA	15	30
MINERAL HOBOKEN	1	
MINERVA	4	
MING GALAXY	1	
MING MOON	22	
MING OCEAN	28	49
MING PLEASURE	1	
MING SPRING	33	
MING UNIVERSE	2	20
MITLA	46	94
MOANA		61
MOANA PACIFIC	18	215
MOANA WAVE	124	
MOBIL ARCTIC	19	91
MOBIL MERIDIAN	124	170
MOKU PAHU	96	57
MORELOS	30	12
MORMACSKY	73	172
MORMACSTAR	49	30
MORMACSUN	72	180
MOSEL EXPRESS	103	
MOSMAN STAR	23	
MSC CHIARA	46	78
MSC SABRINA	38	88
MYRON C. TAYLOR	41	39
NACIONAL SANTOS	18	2
NADA 2	73	222
NANCY LYKES	58	
NARA	38	9
NATIONAL DIGNITY	34	168
NATIONAL HONOR	15	24
NATIONAL PRIDE	26	28
NAVIOS UNIQUE	113	
NECHES		3
NEDLLOYD ALKMAAR	34	
NEDLLOYD BAHRAIN	44	
NEDLLOYD BALTIMORE	62	
NEDLLOYD BANGKOK	79	
NEDLLOYD BARCELONA	51	
NEDLLOYD ELBE	130	
NEDLLOYD HOLLAND	63	163
NEDLLOYD HUDSON	62	146
NEDLLOYD KEMBLA	85	
NEDLLOYD KIMBERLEY	1	
NEDLLOYD KINGSTON	102	
NEDLLOYD KYOTO	154	
NEDLLOYD ROCHESTER	92	
NEDLLOYD ROTTERDAM	94	
NEDLLOYD ROUEN	92	
NEDLLOYD VAN CLOON	22	34
NEPTUNE ACE	18	
NEPTUNE AMBER	102	252
NEPTUNE CORAL	66	143
NEPTUNE CRYSTAL	37	
NEPTUNE DIAMOND	152	
NEPTUNE GARNET	36	
NEPTUNE IVORY	13	
NEPTUNE JADE	63	
NEPTUNE PEARL	73	186
NEPTUNE TOURMALINE	9	
NEW HORIZON	82	97
NEW NOBLE	10	63
NEW RUBY	39	108
NEW TOPAZ		13
NISSAN LAUREL	39	
NOAA DAVID STARR JORDA	93	110
NOAA SHIP ALBATROSS IV	242	236
NOAA SHIP CHAPMAN	77	55
NOAA SHIP DELAWARE II	418	489
NOAA SHIP DISCOVERER O	373	111
NOAA SHIP FAIRWEATHER	45	29
NOAA SHIP FERREL	115	133
NOAA SHIP HECK 591	19	60
NOAA SHIP JOHN N COBB	55	81
NOAA SHIP M. BALDRIDGE	453	408
NOAA SHIP MCARTHUR	31	
NOAA SHIP MILLER FREEM	357	350
NOAA SHIP MT MITCHEL	461	523
NOAA SHIP OREGON II	56	67
NOAA SHIP RAINIER	218	
NOAA SHIP RUDE 590	28	55
NOAA SHIP SURVEYOR	16	19
NOAA SHIP T. CROMWELL	106	135
NOAA SHIP WHITING	152	220
NOBLE STAR	77	
NOSAC EXPRESS	4	117
NOSAC RANGER	64	27
NOSAC SKY	11	57
NOSAC TAI SHAN	38	74
NOSAC TAKARA	21	

Ship Name	radio	mail
NOSAC TAKAYAMA	74	
NOSAC TASCO	31	
NOSAC TRIGGER	73	126
NOSIRA SHARON	88	
NOVA EAGLE	11	
NUEVO SAN JUAN	79	211
NURNBERG EXPRESS	89	
OAXACA	54	
OCEAN ASPIRATION	19	63
OCEAN AUSTRALIA	1	
OCEAN BRIDGE	11	
OCEAN CHEER	12	14
OCEAN LUCKY	38	84
OCEAN SEL	8	121
OCEAN SPIRIT	25	
OCEAN STEELHEAD	11	117
OGDEN WABASH	30	72
OLEANDER	125	77
OLGA TOPIC	49	174
OMI CHAMPION	21	
OOCL AMERICA	7	
OOCL FAIR	40	40
ORANGE BLOSSOM	38	153
ORCHID	64	81
ORCHID *2	33	31
OREGON RAINBOW II	68	167
ORIENTAL DIPLOMAT	52	
ORIENTAL EXECUTIVE	122	120
ORIENTAL EXPLORER	22	102
ORIENTAL FAITH	57	68
ORIENTAL FORTUNE	5	
ORIENTAL FREEDOM	64	
ORIENTAL KNIGHT	41	87
ORIENTAL MINISTER	13	
ORIENTAL PATRIOT	42	132
ORIENTAL PHOENIX		43
ORION HIGHWAY	74	82
OVERSEAS ALICE	75	134
OVERSEAS BOSTON		87
OVERSEAS HARRIET	53	27
OVERSEAS JOYCE	84	87
OVERSEAS JUNEAU		50
OVERSEAS MARILYN	24	81
OVERSEAS NEW YORK	31	40
OVERSEAS OHIO	4	
OVERSEAS VIVIAN	22	32
OVERSEAS WASHINGTON	28	58
PACDUCHESS	65	47
PACDUKE	19	12
PACEMPEROR	29	
PACGLORY	38	
PACIFIC ANGEL	22	
PACIFIC ARROW	99	90
PACIFIC DAWN	58	52
PACIFIC PRINCESS	55	
PACIFIC SENTRY	13	
PACIFIC VICTORY	37	12
PACKING	3	
PACMAJESTY	30	
PACMERCHANT	11	15
PACNOBLE	20	
PACPRINCE	35	
PACPRINCESS	12	14
PACTRADER	28	24
PAN FORTUNE	20	
PAN UNION	1	
PATRIOT	39	22
PAUL BUCK	90	17
PAUL H. TOWNSEND	11	
PAUL THAYER	4	
PEARL ACE	23	
PECOS	14	28
PEGGY DOW	148	
PENNSYLANIA RAINBOW	58	
PENNSYLVANIA TRADER	70	32
PERMEKE	63	
PERSEVERANCE	43	
PETER W. ANDERSON	26	
PETERSFIELD	1	
PFC DEWAYNE T. WILLIAM	2	
PFC EUGENE A. OBREGON	11	10
PFC JAMES ANDERSON JR	20	18
PFC WILLIAM B. BAUGH	23	11
PHAROS	124	
PHILIP R. CLARKE	171	120
PHILIPPINE VICTORY	1	
POLAR ALASKA	10	184
POLYNESIA	214	20
POQUITA MAMI	33	158
POTOMAC TRADER	14	26
PRESIDENT ADAMS	80	139
PRESIDENT ARTHUR	55	45
PRESIDENT BUCHANAN	17	56
PRESIDENT EISENHOWER	74	110
PRESIDENT F. ROOSEVELT	89	147
PRESIDENT GRANT	60	111
PRESIDENT HARDING	43	35
PRESIDENT HARRISON	113	178
PRESIDENT HOOVER	62	140
PRESIDENT JACKSON	71	190
PRESIDENT JOHNSON	20	30
PRESIDENT KENNEDY	76	105
PRESIDENT LINCOLN	137	117
PRESIDENT MADISON	87	127
PRESIDENT MONROE	88	177
PRESIDENT PIERCE	15	90
PRESIDENT POLK	63	203
PRESIDENT TRUMAN	98	110

Ship Name	radio	mail
PRESIDENT TYLER	14	35
PRESIDENT WASHINGTON	112	114
PRESQUE ISLE	106	252
PRINCE OF TOKYO	60	149
PRINCE OF TOYKO II	101	149
PRINCE WILLIAM SOUND	53	170
PRINCESS DIAN	14	62
PROJECT AMERICAS	43	
PUERTO CORTES	117	86
PUNTA BRAVA	27	29
PURITAN	131	
PVT HARRY FISHER	22	
QUEEN ELIZABETH 2	18	
RAINBOW BRIDGE	88	54
RAINBOW HOPE	255	203
RALEIGH BAY	41	122
RANGER	53	4
RANI PADMINI	22	59
REGINA MAERSK	19	68
RESERVE	116	232
RHINE FOREST	54	48
RICHARD G MATTIESEN	91	105
RICHARD REISS	24	54
RIJEKA EXPRESS	30	
RIMBA KERVING	8	
RIMBA SEPETIR	3	
RIO ESQUEL	80	19
RIO FRIO	161	
RIO GRANDE	2	
RIO LIMAY	18	
ROBERT CONRAD	4	5
ROBERT E. LEE	21	30
ROGER BLOUGH	61	73
ROGER R. SIMONS	10	
ROSETTA	2	8
ROSINA TOPIC	33	
ROTTERDAM	47	
ROVER		73
ROYAL PRINCESS	89	
ROYAL VIKING SKY	9	
RUTH LYKES	35	28
S.T. CRAPO	54	126
SAM HOUSTON	11	
SAMOAN REEFER	88	85
SAMRAT ASHOK	27	
SAMU	2	
SAN MARTIN I	31	
SAN MATEO VICTORY	4	44
SAN MIGUEL BAY	21	
SANKO DIGNITY	15	
SANKO MARQUESA	1	
SANKO MOON	1	
SANKO PEACE	10	
SANKO PRELUDE	77	69
SANKO STORK	10	
SANSINENA II	50	71
SANTA ADELA	53	97
SANTA CRUZ II	44	
SANTA JUANA	94	61
SANTA VICTORIA	43	42
SANWA MARU	48	
SATURN DIAMOND	28	149
SAUDI ABHA	31	
SAUDI DIRIYAH	43	
SAUDI HOFUF	10	
SAUDI MAKKAH	9	
SAUDI RIYADH	5	
SAUDI TABUK	64	
SAVANNAH	139	
SCARAB	52	18
SEA ACE	23	89
SEA BELLS	22	20
SEA COMMERCE	67	
SEA DIAMOND	11	
SEA FAN	71	132
SEA FORTUNE	30	115
SEA FOX	27	84
SEA LANTERN	31	138
SEA LIGHT	31	91
SEA LION	181	199
SEA MERCHANT	3	
SEA TRADE	159	
SEA WOLF	192	208
SEALAND ANCHORAGE	44	39
SEALAND ATLANTIC	65	
SEALAND CHALLENGER	49	51
SEALAND COMMITMENT	38	
SEALAND CRUSADER	55	118
SEALAND DEFENDER	92	130
SEALAND DISCOVERY	115	171
SEALAND ENDURANCE	29	116
SEALAND ENTERPRISE	151	149
SEALAND EXPEDITION	15	80
SEALAND EXPLORER	60	152
SEALAND EXPRESS	46	128
SEALAND FREEDOM	63	112
SEALAND HAWAII	108	193
SEALAND INDEPENDENCE	54	75
SEALAND INNOVATOR	56	107
SEALAND KODIAK	24	14
SEALAND LIBERATOR	70	163
SEALAND MARINER	73	191
SEALAND NAVIGATOR	85	183
SEALAND PACIFIC	86	177
SEALAND PATRIOT	73	35
SEALAND PERFORMANCE	36	62
SEALAND PRODUCER		21
SEALAND QUALITY	37	132
SEALAND TACOMA	39	139

Ship Name	radio	mail
SEALAND TRADER	99	180
SEALAND VOYAGER	102	171
SEAWARD BAY	34	
SEDCO/BP 471	35	16
SENATOR		123
SEVEN OCEAN	67	20
SGT WILLIAM A BUTTON	4	
SGT. METEJ KOCAK	11	16
SHELDON LYKES	95	44
SHELLY BAY	23	11
SHENANDOAH	41	6
SHIN BEISHU MARU	50	
SHINKASHU MARU	114	
SILVER CLIPPER	44	33
SINGA ACE	32	
SINGAPORE VICTORY	16	45
SIOUX TATE	29	26
SKANDERBORG	64	102
SKAUBORD	75	104
SKAUGRAN	90	33
SKEENA	136	
SOLAR WING	83	177
SONBAI	108	155
SONORA	43	95
SOPHIA	77	
SOUTHLAND STAR	66	
SPRING BEAR	125	
SPRING BEE	31	42
SPRING SWIFT	10	
ST EMILION	9	
STAR EAGLE	49	84
STAR ESPERANZA	107	158
STAR EVVIVA	19	
STAR FLORIDA	82	
STAR FUJI	20	
STAR GEIRANGER	11	
STAR GRAN	70	157
STAR HONG KONG	84	
STAR MINERVA	44	121
STAR OF TEXAS	25	69
STAR RANGER	15	
STATE OF MAINE	17	
STELLA LYKES	14	30
STEWART J. CORT	120	172
STONEWALL JACKSON	12	
STRATHCONON	130	
STRIDER ISIS	49	57
STUTTGART EXPRESS	62	
SUE LYKES	5	47
SUGAR ISLANDER	27	
SUN PRINCESS	1	
SUNBELT DIXIE	151	124
SUNNY SUPERIOR	8	185
SUNWARD II	1	
SUSAK	4	
SWIFT TRADER	15	
SWIFTNES	54	82
TABASCO	60	158
TAI CORN	32	
TAI SHING	8	
TALISMAN	31	11
TAMPA	9	
TARGET	126	196
TAYABAS BAY	10	
TEXACO NEW YORK	93	118
TEXACO VERAGUAS	107	133
THE PERFORMER	12	
THOMAS WASHINGTON	96	107
THOMPSON LYKES	57	28
THOMPSON PASS	25	50
TIGLAX		1
TOBA	34	54
TOHZAN	41	59
TOKYO HIGHWAY	1	
TOKYO MARU	51	
TOLUCA	3	63
TOMCI TOPIC	8	105
TONSINA	59	109
TOWER BRIDGE	76	
TRONDANGER	1	52
TROPICAL BEAUTY	33	19
TROPICALE	202	225
TRUDY	55	
TULSIDAS	88	
TUNISIAN REEFER	48	25
TUVA	35	76
ULTRAMAR	48	51
ULTRASEA	23	84
UMAMONTE	45	59
UNI-SPRING	58	237
UNI-SUMMIT	54	43
UNI-SUPERB	5	22
UNIVERSE	16	
URTE	71	149
USCGC ACTIVE WMEC 618	22	
USCGC ALERT (WMEC 630)	6	
USCGC BASSWOOD (WLB 38	44	
USCGC BISCAYNE BAY	7	24
USCGC BUTTONWOOD WLB 3	29	
USCGC CHEROKEE WMEC 16	52	
USCGC CHILULA (WMEC 15	29	
USCGC CITRUS (WMEC 300	215	
USCGC CLOVER (WMEC 292	38	
USCGC CONIFIR(WLB 301)	23	43
USCGC COURAGEOUS		103
USCGC DEPENDABLE	21	
USCGC EAGLE (WIX 327)	75	

Ship Name	radio	mail
USCGC ESCANABA	55	
USCGC EVERGREEN WMEC 2	33	
USCGC FIREBUSH WLB 393	6	
USCGC HAMILTON WHEC 71	17	
USCGC HARRIET LANE	4	
USCGC IRONWOOD (WLB 29	112	134
USCGC JARVIS (WHEC 725	68	166
USCGC KATMAI BAY	7	6
USCGC MACKINAW	19	26
USCGC MALLOW (WLB 396)	21	
USCGC MESQUITE (WLB 30	6	
USCGC MIDGETT (WHEC 72	36	37
USCGC MOBIL BAY	2	4
USCGC MORGENTHAU	33	
USCGC NAUSHON	3	5
USCGC NEAH BAY	7	
USCGC NORTHLAND WMEC 9	85	
USCGC PLANETREE	7	43
USCGC POLAR SEA WAGB 1	4	2
USCGC POLAR STAR WAGB	138	67
USCGC RELIANCE WMEC 61	1	
USCGC RESOLUTE WMEC 62	42	
USCGC SALVIA (WLB 400)	7	
USCGC SASSAFRAS	22	
USCGC SPENCER	5	
USCGC STEADFAST WMEC 6	2	52
USCGC STORIS (WMEC 38)	46	142
USCGC SUNDEW (WLB 404)	34	
USCGC SWEETBRIER WLB 4	53	84
USCGC TAMAROA (WMEC 16	1	
USCGC TAMPA WMEC 902		45
USCGC THETIS	24	
USCGC VOCOMA (WMEC 168	99	138
USNS A.J.HIGGINS		27
USNS ADVENTUROUS		53
USNS ALTAIR	44	
USNS APACHE (T-ATF 172	3	
USNS BELLATRIX	2	
USNS CHAUVENET TAGS 29	24	
USNS DE STEIGUER		86
USNS DENEBOLA	2	
USNS GUS W. DARNELL	31	43

Ship Name	radio	mail
USNS HARKNESS (T-AGS 3		64
USNS HENRY J. KAISER		83
USNS JOHN LENTHAL		33
USNS JOSHUA HUMPREYS	115	
USNS MERCURY	25	
USNS MISSISSINEWA		67
USNS MOHAWK (T-ATF 170	19	
USNS NARRAGANSETT	87	162
USNS NAVAJO	69	
USNS PASSUMPSIC TAO 10		91
USNS POLLUX	22	
USNS POWHATAN TATF 166	86	68
USNS RANGE SENTINEL	5	
USNS REDSTONE	2	
USNS SATURN T-AFS-10		71
USNS SEALIFT ANTARCTIC	33	76
USNS SEALIFT ARABIAN S	22	43
USNS SEALIFT ARCTIC	13	9
USNS SEALIFT ATLANTIC	17	14
USNS SEALIFT CARIBBEAN	58	80
USNS SEALIFT CHINA SEA	43	127
USNS SEALIFT IND'N OCE	25	39
USNS SEALIFT MED	5	
USNS SEALIFT PACIFIC	55	64
USNS SPICA (T-AFS 9)		74
USNS TRUCKEE (T-AO 147		47
USNS VANGUARD TAG 194	37	97
USNS WACCAMAW(TAO-109)		33
VALLEY FORGE	28	159
VAN HAWK	50	
VAN TRADER	26	40
VERRAZANO BRIDGE	47	18
VIRGO	10	98
VISHVA PALLAV	26	
VISHVA PANKAJ	29	
VISHVA PARAG	41	
VISHVA PRAFULLA	2	
VISHVA SHAKTI	2	
VISHVA SIDDHI	2	
WASHINGTON HIGHWAY	187	
WASHINGTON RAINBOW *2	29	85
WESER EXPRESS	17	

Ship Name	radio	mail
WESTOCEAN	1	
WESTWARD VENTURE	78	112
WESTWOOD ANETTE	153	239
WESTWOOD BELINDA	15	
WESTWOOD CLEO	92	
WESTWOOD JAGO	145	148
WESTWOOD MARIANNE	37	154
WESTWOOD MERCHANT		57
WESTWOOD MERIT	5	14
WESTWOOD MUSKETEER	33	7
WHITE ROSE	47	
WILFRED SYKES	109	138
WILHELM SCHULTE	69	95
WILLIAM E. MUSSMAN	2	
WILLIAM J. DELANCEY	260	303
WILLIAM R. ROESCH	135	219
WINTER SUN	10	
WINTER WAVE	63	88
WOLVERINE	41	70
WORLD WING *2	67	41
YACU WAYO	13	
YAMATAKA MARU	88	
YANKEE CLIPPER	88	
YORKTOWN SEA	24	15
YOUNG SCOPE	83	
YOUNG SKIPPER	12	
YOUNG SOLDIER	44	
YOUNG SPROUT	60	
ZEELANDIA	80	
ZEUS	9	
ZIM GENOVA	43	
ZIM HAIFA	20	
ZIM HONGKONG	35	
ZIM HOUSTON	27	
ZIM IBERIA	55	
ZIM KEELUNG	41	
ZIM MARSEILLES	3	
ZIM MIAMI	31	
ZIM NEW YORK	53	
ZIM SAVANNAH	43	
ZIM TOKYO	35	

Summary of U.S. VOS Weather Reports

Grand Total Via Radio – 53,419
Unique Radio Obs. – 30,753 (35.4%)
Grand Total Via Mail – 56,242

Total Duplicates – 22,666 (26.1%)
Total Unique Obs. – 86,995
Unique Mail Obs. – 33,576 (38.6%)

Top Ships

Radio
NOAA Ship Mt Mitchell
Rainbow Hope

Mail
NOAA Ship Mt Mitchell
Lewis Wilson Foy

April, May and June 1989

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
H3BZ	42	42	0	ACT 12
A8VI	21	21	0	PACDUCHESS
BNTB	11	11	0	***
CBVM	22	22	0	VINA DEL MAR
CGBS	157	0	157	PARIZEAU
CGDU	37	37	0	W. TEMPLEMAN
CG2959	1	1	0	LEONARD J. COWLEY
CTFS	9	9	0	***
CXFN	4	4	0	PRESIDENTE RIVERA
C7C	213	70	143	OCEAN STATION CHARLIE
C7L	135	135	0	OCEAN STATION LIMA
DAKE	120	120	0	KOELN ATLANTIC
DA9100	102	102	0	***
DBBX	4	0	4	GAUSS
DESI	9	9	0	VALDIVIA
DGLM	36	36	0	MONTE ROSA
DGVK	47	47	0	COLUMBUS VICTORIA
DGZV	41	41	0	COLUMBUS VIRGINIA
DGZU	1	1	0	***
DHCN	101	101	0	COLUMBUS WELLINGTON
DHJN	80	80	0	ACT 9
DHOU	29	29	0	PURITAN
DLEZ	31	31	0	YANKEE CLIPPER
DRAV	4	4	0	***
D5NE	55	55	0	MT CABRITE
D5NZ	78	78	0	POLYNESIA
ELBX3	3	3	0	PACKING
ELDN8	58	58	0	SEAL ISLAND
ELED8	8	8	0	PACPRINCESS
EREA	67	60	7	MUSSON
ERED	97	88	9	VOLNA
EREC	128	21	107	PRILIV
EREH	66	0	66	PRIBOY
EREI	161	17	144	OKEAN
ERES	71	63	8	VICTOR BUGAEV
ERET	128	122	6	GEORGE OUSHAKOV
EREU	82	80	2	ERNST KRENKEL
ESGU	277	0	277	PERCY 3
FALJ	3	3	0	***
FATV	2	2	0	***
FNCZ	59	59	0	LIBREVILLE
FNGB	2	2	0	MARION DUFRESNE
FNGS	38	38	0	LAFAYETTE
FNIB	7	7	0	THALASSA
FNJT	37	37	0	KORRIGAN
FNOM	28	28	0	ANGO
FNPA	46	46	0	RONSARD
FNQB	51	51	0	ILE MAURICE
FNQC	49	49	0	VILLE DE ROUEN
FNQN	32	32	0	VILLE DE MARSEILLE
FNZ0	35	35	0	RABELAIS
FNZP	42	42	0	RACINE
FNZQ	70	70	0	RIMBAUD
FPID	9	9	0	ROSPICO
FPY0	20	20	0	CAP SAINT PAUL
GACA	16	16	0	***
GDLS	5	5	0	DARWIN
GLNE	94	94	0	DISCOVERY
GMAM	19	19	0	CIROLANA
GOVN	34	34	0	ACT 6
GPNN	8	8	0	FARNELLA
GWOJ	3	3	0	***
GYAN	29	29	0	ENCOUNTER BAY
GYSA	50	50	0	FLINDERS BAY
GYSE	17	17	0	NEDLLOYD TASMAN
GZIS	2	2	0	***
GZKA	27	27	0	ACT 3
HCGE	6	6	0	***
HO4667	17	17	0	***
HPAN	26	26	0	MICRONESIAN COMMERCE
HPEN	52	52	0	PACIFIC ISLANDER
H9BQ	44	44	0	MICRONESIAN INDEPENDANCE
IGMA	12	12	0	***
JBOA	68	68	0	KEIFU MARU
JBRA	23	23	0	JAPAN TUNA II
JCCX	150	150	0	CHOFU MARU
JCBF	87	87	0	SOYO MARU
JCDT	8	8	0	AMERICA MARU
JCIN	47	47	0	TOKYO MARU
JCOB	76	76	0	SHOYO
JDAB	3	3	0	SHOYO MARU
JDUX	113	113	0	***
JFCI	22	22	0	***
JFDG	77	77	0	SHUNPU MARU
JGZK	82	82	0	RYOFU MARU
JITV	19	19	0	***
JJZC	15	15	0	HAKONE MARU
JLTI	8	8	0	***
JNTO	8	8	0	***
JPJX	59	59	0	HAKURYU MARU
JPUB	78	78	0	SEIFU MARU
JSVY	10	10	0	SHIRASE
KGWU	46	46	0	TH. WASHINGTON
KIRH	16	16	0	SEALAND TRADER
KNBD	23	23	0	DELAWARE II
KRGB	56	56	0	SEALAND ENTERPRISE
LZTI	1	1	0	***
MAEE	2	2	0	DE STEIGUER
MAQD	58	58	0	JARVIS
MAVOCE	2	2	0	US NAVAL OCEANOGRAPHIC
MBHO	33	33	0	***
MBTH	49	49	0	POLAR STAR
MCQI	2	2	0	***
MDIT	5	5	0	MELLON
MDUA	17	17	0	MORGENTHAU
MEKF	28	28	0	LYNCH
MFKQ	3	3	0	SEALIFT ARABIAN SEA
MIDK	18	18	0	***
MJPG	1	1	0	***
MLGF	26	26	0	NORTHLAND
MMEL	11	11	0	***
MMOB	1	1	0	***
MMST	1	1	0	HAMLON S. TISDALE
MMAS	25	25	0	ESCANABA
MOMU	1	1	0	***
MQST	36	36	0	SEALIFT ARCTIC
MRCB	11	11	0	EAGLE
MRL	49	49	0	***
MRUC	3	3	0	***
MYGG	110	110	0	CHAUVENET
OUEQ2	12	12	0	MCKINNEY MAERSK
OXFB2	6	6	0	LEDA MAERSK
OXMD2	6	6	0	LARS MAERSK
PGDG	50	50	0	NEDLLOYD KINGSTON
PGDS	38	38	0	NEDLLOYD KYOTO
PGDT	36	36	0	NEDLLOYD BALTIMORE
PGDU	36	36	0	NEDLLOYD BANGKOK
PGEN	46	46	0	NEDLLOYD BAHREIN
PGEH	12	12	0	NEDLLOYD BARCELONA
PJVG	65	65	0	OLEANDER
P3EU	48	48	0	WILHELM SCHULTE
SEPI	2	0	2	***
SHIP	728	728	0	***
S6FE	35	35	0	SUNN REEFER
TFEA	4	4	0	BJARNI SAEMUNDSSON
UBNZ	96	96	0	SHULEYKIN AKADEMIK
UEAE	24	0	24	VALERIAN URYVAYEV
UHQS	149	1	148	AKADEMIK KOROLEV
UMFU	21	21	0	PROF. ZUBOV
UMUZ	4	4	0	MIRNY
UNAS	1	0	1	***
UNIF	4	4	0	***
UPUI	114	114	0	PROFESSOR VIZE
UQYC	5	5	0	AKADEMIK FEDOROV
USCG	16	16	0	U.S. COAST GUARD
UUQR	8	8	0	MOLCHANOV PAVEL PRO
UUMJ	9	9	0	USEVOLOD BERYOZKIN
UUMN	152	116	36	GAKKEL, YAKOV
UWEC	121	13	108	PROFESSOR KHROMOV
UWFN	7	0	7	***
UZGN	38	29	9	PASSAT
VCBT	22	22	0	CAPE ROGER
VCTF	21	21	0	CAPE BRIER
VC9450	12	12	0	GADUS ATLANTICA
VJBQ	6	6	0	ANRO AUSTRALIA
VJDI	36	36	0	IRON NEWCASTLE
VKCK	17	17	0	STUART
VKCN	4	4	0	CANBERRA
VKCU	48	48	0	DERWENT
VKDA	64	64	0	DARWIN
VKLC	143	143	0	BRISBANE
VKML	87	87	0	SNIPE
VKMN	24	24	0	TEALE
VKMS	332	332	0	COOK
VLHB	45	45	0	TORRENS
VNAF	4	4	0	***
VNAP	133	133	0	AUSTRALIAN PROGRESS
VPI7	1	1	0	AIRCRAFT SQUADRON
VXHB	159	159	0	AIRCRAFT
WCGM	32	32	0	CHEVRON CALIFORNIA
WDAG	6	6	0	SHENANDOA
WECB	64	64	0	MELVILLE
WHDA	3	3	0	R.V.CONRAD
WMVF	65	65	0	ALBATROSS IV
WRA4560	39	39	0	BOLD VENTURE
WRBA	10	10	0	***
WRDB	11	11	0	***
WSB3620	12	12	0	ROYAL DAWN
WSE3385	40	40	0	GLORITA
WSG6552	17	17	0	IPOCI
WTDF	8	8	0	T. CROMWELL
WTDK	24	24	0	D.S. JORDAN
WTDM	47	47	0	M.FREEMAN
WTEA	81	81	0	DISCOVERER
WTEB	5	5	0	FAIRWEATHER
WTED	41	41	0	CHAPMAN
WTEF	7	7	0	RAINIER
WTEG	12	12	0	MOUNT MITCHELL
WTEA	188	188	0	M. BALDRIDGE
WTES	10	10	0	SURVEYOR
WTEW	6	6	0	WHITING
WTEZ	6	6	0	FERREL
WXBR	70	70	0	CHEVRON MISSISSIPPI
WX07334	6	6	0	PETER ANDERSON
WYA467	2	2	0	***
WZE39	23	23	0	MOANA WAVE
ZCSK	75	75	0	SKEENA
ZCSL	80	80	0	MINOS
ZCUZ	1	1	0	POYANG
ZMFS	11	11	0	***
3BBA	20	20	0	MAURITIUS
3EAD7	22	22	0	ZEUS
3EET4	21	21	0	SEAS EIFFEL
3EIX2	15	15	0	PRESIDENTE IBANEZ
3EZ65	12	12	0	HIKAUA II
3FHI2	92	92	0	MOANA PACIFIC
5MCB	5	5	0	ABERDINE
7JDB	68	68	0	SHINKASHU MARU
7KDB	35	35	0	YOKO MARU
8LAY	3	3	0	***
9VBZ	17	17	0	MANSURI
9VUU	7	7	0	ANRO ASIA

TOTAL BATHYS RECEIVED 8275
TOTAL TESACS RECEIVED 1265
TOTAL REPORTS RECEIVED 9540

April, May and June 1989

Wave observations are taken each hour during a 20–minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one–third of the waves during the hourly averaging period. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0–minute averaging period each hour (moored buoys) and a 2.0–minute averaging period for fixed stations (C–MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688–2838 for more details.

APRIL 1989

	Station	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
Buoy	32302	18.0S	085.1W	0712	21.1	22.2	2.4	3.9	06/08	14.0	SE	22.7	01/04	1015.4
	41001	34.9N	072.9W	0717	17.8	20.6	2.2	7.1	08/06	16.0	SW	36.4	16/05	1017.7
	41006	29.3N	077.4W	0718	22.7	23.7	1.5	3.2	12/06	10.8	SW	23.8	07/21	1017.5
	41008	30.7N	081.1W	0720	18.4	18.5	0.9	2.2	11/10	10.0	S	24.3	01/10	1017.1
	41009	28.5N	080.2W	1434	22.2	22.9	1.0	2.6	01/13	10.3	SE	25.6	30/18	1018.2
	41010	28.9N	078.5W	1437	22.6	23.6	1.3	3.1	13/00	11.7	S	26.2	08/01	1017.9
	42002	26.0N	093.5W	0701	22.6	23.2	1.1	3.9	11/06	12.4	SE	29.1	11/00	1015.6
	42003	25.9N	085.9W	0712	21.0	24.3	0.7	2.2	11/14	9.1	E	23.5	06/12	1016.8
	42007	30.1N	088.8W	0684	19.5	21.0	0.4	1.3	12/21	11.5	S	29.3	11/04	1017.7
	42015	30.2N	088.2W	0718	19.4	20.9	0.5	1.5	07/09	10.0	S	24.1	11/10	1017.6
	42016	30.2N	088.1W	0711	19.4	20.6	0.4	1.1	07/08	10.4	S	27.6	05/07	1017.3
	42017	27.9N	090.9W	0146	24.4	24.5				8.9	SE	21.6	28/22	1013.7
	44004	38.5N	070.6W	0720	12.1	14.4	2.1	7.3	16/06	13.9	NW	40.0	08/11	1016.4
	44005	42.7N	068.6W	0720	5.2	5.0	1.6	6.6	17/03	11.1	SW	29.1	16/15	1015.2
	44007	43.5N	070.1W	0714	4.5	4.1	0.9	4.0	17/06	10.2	N	27.2	07/07	1014.0
	44008	40.5N	069.5W	0718	6.7	6.1	1.6	6.5	16/17	13.4	S	36.7	17/00	1015.2
	44009	38.5N	074.6W	0704	9.4	8.6	1.0	3.3	16/03	11.2	S	31.5	07/23	1016.7
	44011	41.1N	066.6W	0715	5.6	5.1	2.0	6.5	16/20	11.0	S	30.4	08/18	1015.7
	44013	42.4N	070.8W	0718	5.6	4.8	0.7	3.9	16/21	12.0	SE	33.2	16/19	1014.8
	45001	48.0N	087.7W	0128	1.8	0.9	0.7	1.9	29/13	9.2	NE	21.6	29/12	1018.5
	45003	45.3N	082.7W	0011	3.9					3.6	SE	6.8	30/14	1017.3
	45004	47.6N	086.5W	0137	2.0	0.9	0.5	1.4	30/10	8.0	N	18.5	30/10	1017.9
	45006	47.3N	089.9W	0082	1.7	0.9	0.7	2.2	29/16	11.5	NE	23.1	29/15	1018.6
	45007	42.7N	087.1W	0717	1.9	2.7	0.5	2.2	10/01	9.0	S	23.1	14/13	1016.4
	45008	44.3N	082.4W	0022	4.0	1.6	0.2	0.5	30/18	7.7	SE	13.2	30/21	1016.2
	46001	56.3N	148.3W	0720	3.9	4.2	1.8	4.9	10/06	9.7	E	22.7	23/09	1013.9
	46002	42.5N	130.4W	0718	10.1	10.5	2.2	5.2	21/03	12.8	S	23.6	01/07	1018.8
	46005	46.1N	131.0W	0718	8.1	8.3	2.1	6.4	02/13	12.1	NE	27.7	01/23	1018.1
	46006	40.8N	137.6W	0719	11.3	11.8	2.4	6.2	20/17	14.8	SE	31.1	01/02	1015.7
	46010	46.2N	124.2W	0588	9.9	10.2	1.8	5.3	02/21	13.4	S	31.9	01/17	1017.3
	46011	34.9N	120.9W	0719	13.3	12.7	1.6	3.4	02/02	9.6	NW	24.7	03/22	1016.9
	46012	37.4N	122.7W	0720	12.5	13.0	1.5	3.0	01/18	9.2	NW	21.0	11/02	1018.0
	46013	38.2N	123.3W	0719	11.7	11.8				9.1	NW	31.2	11/00	1017.3
	46014	39.2N	124.0W	0718	11.5	11.9	1.8	3.7	01/15	9.6	N	28.5	11/03	1016.8
	46022	40.8N	124.5W	0720	10.9	11.5	1.9	4.0	21/21	8.3	N	24.6	01/21	1017.9
	46023	34.3N	120.7W	0720	13.6	13.4	1.6	3.3	02/06	12.6	NW	25.4	04/13	1015.9
	46025	33.7N	119.1W	0719	15.6	15.8	1.0	2.4	03/02	7.7	W	27.2	02/04	1014.9
	46026	37.8N	122.7W	0715	12.1	12.6	1.3	2.5	01/17	9.2	NW	26.6	10/16	1017.1
	46027	41.8N	124.4W	0709	10.3	10.6	1.7	4.4	21/19	9.6	S	28.6	12/00	1019.8
	46028	35.8N	121.9W	0719	12.8	13.0	1.8	4.0	11/08	8.9	NW	25.3	11/03	1016.8
	46030	40.4N	124.5W	0718	10.6	10.5	1.8	4.2	01/09	11.5	N	27.0	01/19	1017.2
	46035	57.0N	177.7W	0695	0.7	2.0	2.8	8.2	16/20	17.9	W	40.2	16/17	1008.6
	46040	44.8N	124.3W	0718	10.2	10.4	1.9	5.8	02/22	11.2	N	29.1	01/17	1017.9
	46041	47.4N	124.5W	0709	9.7	10.3	1.7	5.7	02/21	10.0	NW	27.2	01/16	1017.8
	46042	36.8N	122.4W	0717	12.4	12.8	1.7	3.5	22/08	8.9	NW	24.5	11/01	1018.1
	46125	33.7N	119.1W	0709			1.0	2.5	03/02					
	51002	17.2N	157.8W	0609	24.0	25.4	2.3	3.4	08/03	13.9	E	23.4	20/19	1014.2
	51003	19.2N	160.8W	0236	23.9	25.1	2.4	4.7	07/12	14.4	E	25.8	07/15	1015.3
	51004	17.5N	152.6W	0717	24.2	24.9	2.3	3.6	21/21	12.0	E	28.3	01/19	1014.6
	52005	8.6N	144.5E	0174	25.0					0.8	E	2.9	20/10	1008.2
C-Man	ALSN6	40.5N	073.8W	0714	8.6	7.2				13.8	NW	35.1	04/17	1015.4
	BURL1	28.9N	089.4W	0715	19.9					11.0	NE	29.3	11/00	1016.5
	BUZM3	41.4N	071.0W	0715	6.3					14.2	S	38.7	16/13	1014.7
	CARO3	43.3N	124.4W	0717	10.3					8.4	N	26.0	01/20	1018.3
	CHLV2	36.9N	075.7W	0711	11.6	10.8	0.9	3.0	08/02	14.4	S	43.4	08/01	1017.3
	CLKN7	34.6N	076.5W	0697	15.4					9.9	N	32.8	08/01	1017.1
	CSBF1	29.7N	085.4W	0717	19.5					7.3	SW	24.3	07/10	1018.1
	DBLN6	42.5N	079.4W	0716	4.7					10.5	SW	33.9	04/17	1017.0
	DESW1	47.7N	124.5W	0705	9.6					11.2	SE	34.1	01/16	1017.4
	DISW3	47.1N	090.7W	0716	1.5					11.0	NE	36.5	09/09	1016.3
	DPIA1	30.3N	088.1W	0719	19.1	20.4				10.1	S	27.3	11/04	1018.1
	DSLN7	35.2N	075.3W	0718	16.5	19.2	1.6	6.3	07/19	17.2	SW	53.0	07/18	1016.8
	FARP2	8.6N	144.6E	0718	27.9					9.3	E	33.7	20/07	1007.3
	FBIS1	32.7N	079.9W	0712	17.1					8.6	SW	27.2	20/14	1017.7
	FFIA2	57.3N	133.6W	0718	6.5					7.9	N	24.7	03/10	1018.2
	FPSN7	33.5N	077.6W	0717	17.5					15.6	S	47.1	07/18	1017.3
	GDIL1	29.3N	090.0W	0719	20.4	22.0				10.1	S	27.0	11/02	1016.6
	GLLN6	43.9N	076.4W	0706	3.5					10.4	W	28.5	09/21	1016.0
	IOSN3	43.0N	070.6W	0716	5.0					13.2	NW	33.8	16/17	1015.3
	LKWF1	26.6N	080.0W	0714	23.3	24.7				8.9	SE	25.0	30/15	1016.9
	MDRM1	44.0N	068.1W	0715	3.6					15.1	NW	41.1	07/08	1013.6
	MISM1	43.8N	068.9W	0716	3.7					14.1	W	39.1	07/08	1013.8
	MLRF1	25.0N	080.4W	0712	24.6	25.6				9.3	E	23.2	17/17	1016.8
	MPCL1	29.4N	088.6W	0719	20.4					11.4	E	28.0	10/23	1016.8
	NWPO3	44.6N	124.1W	0720	10.5					8.7	S	30.0	01/18	1018.0
	PILM4	48.2N	088.4W	0719	0.5					11.0	NE	29.8	08/12	1016.6
	PTAC1	39.0N	123.7W	0718	10.7					7.7	N	23.0	12/21	1017.1
	PTAT2	27.8N	097.1W	0714	20.4					11.9	SE	30.2	10/17	1015.2
	PTGC1	34.6N	120.7W	0718	13.4					11.4	N	28.3	04/10	1016.7
	ROAM4	47.9N	089.3W	0681	1.1					13.2	NE	34.4	08/11	1017.2
	SAUF1	29.9N	081.3W	0718	19.5	19.8				10.0	N	26.8	12/01	1018.1
	SBIO1	41.6N	082.8W	0715	6.6					10.5	E	33.7	10/04	1016.6

APRIL 1989

	Station	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	SGNW3	43.8N	087.7W	0715	3.6					9.6	N	27.3	14/09	1015.7
	SISW1	48.3N	122.8W	0718	9.4					7.5	W	33.1	01/18	1017.2
	SMKF1	24.6N	081.1W	0706	24.9	25.5				9.5	E	21.8	04/12	1017.3
	SPGF1	26.7N	079.0W	0712	24.1	26.1				6.2	E	22.8	08/01	1017.6
	SRST2	29.7N	094.1W	0716	19.5					11.2	S	23.0	02/02	1016.8
	STDM4	47.2N	087.2W	0719	0.9					13.2	N	33.1	17/12	1015.7
	SULS1	32.0N	080.7W	0704	17.5	17.4				13.4	S	34.4	07/12	1017.3
	TPLM2	38.9N	076.4W	0714	11.4	11.1				10.4	S	25.6	01/00	1016.4
	TTIW1	48.4N	124.7W	0719	9.4					11.3	NE	37.1	09/14	1017.9
	VENF1	27.1N	082.5W	0717	21.4	24.5				7.9	E	24.6	30/07	1017.2
	WPOW1	47.7N	122.4W	0718	10.3					8.8	S	27.6	06/23	1017.5

MAY 1989

	Station	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
Buoy	32302	18.0S	085.1W	0723	19.4	20.9	2.1	3.7	11/04	12.5	NE	24.5	05/10	1017.5
	41001	34.9N	072.9W	0737	20.9	22.7	1.7	4.9	10/21	13.5	S	31.1	18/14	1017.9
	41006	29.3N	077.4W	0739	24.4	25.0	1.1	2.2	02/14	8.6	S	26.9	24/07	1017.7
	41008	30.7N	081.1W	0736	22.5	22.8	0.7	2.2	29/01	9.4	S	24.7	23/23	1016.7
	41009	28.5N	080.2W	1468	24.4	21.7	0.7	1.8	02/01	8.9	SE	32.6	22/01	1018.1
	41010	28.9N	078.5W	1467	24.5	25.4	1.0	2.6	02/08	9.7	E	24.5	02/11	1018.1
	42001	25.9N	089.7W	0334	27.0	27.2	0.9	2.1	18/12	11.9	S	22.5	19/08	1016.3
	42002	26.0N	093.5W	0735	25.6	25.8	1.1	2.9	17/14	13.4	S	26.8	17/12	1014.5
	42003	25.9N	085.9W	0736		25.9	0.6	2.5	02/01	8.8	SE	23.9	01/08	1016.8
	42007	30.1N	088.8W	0729	24.3	25.2	0.4	0.8	23/03	12.1	S	27.2	05/13	1016.8
	42015	30.2N	088.2W	0740	24.2	24.8	0.6	1.6	05/15	10.6	SW	22.2	20/05	1016.8
	42016	30.2N	088.1W	0730	24.1	24.6	0.5	1.3	05/12	10.8	SW	23.1	01/12	1016.5
	42017	27.9N	090.9W	0739	25.5	25.5				9.4	S	22.2	01/05	1015.7
	44004	38.5N	070.6W	0737	16.1	16.9	1.7	5.4	11/08	11.6	SW	30.0	02/21	1015.8
	44005	42.7N	068.6W	0737	9.4	8.2	1.3	3.1	12/13	9.1	SW	24.6	02/22	1016.0
	44007	43.5N	070.1W	0737	10.3	8.8	0.9	3.8	06/17	9.5	S	33.0	06/15	1014.2
	44008	40.5N	069.5W	0740	10.3	9.1	1.3	3.0	07/11	12.2	SW	27.6	11/11	1015.6
	44009	38.5N	074.6W	0736	14.8	13.7	0.9	2.9	06/10	10.7	S	33.6	06/08	1015.2
	44011	41.1N	066.6W	0739	9.2	8.0	1.5	3.6	07/10	9.0	SW	22.2	03/05	1016.5
	44013	42.4N	070.8W	0737	12.1	9.8	0.6	1.8	06/15	11.2	SE	29.5	03/19	1014.6
	45001	48.0N	087.7W	0736	3.5	1.8	0.5	2.7	05/21	7.1	SE	23.9	05/18	1014.6
	45002	45.3N	086.4W	0279	6.0	2.8	0.3	1.1	25/08	7.4	S	25.8	30/02	1012.2
	45003	45.3N	082.7W	0731	4.5	2.4	0.5	2.1	07/18	9.0	NW	24.5	26/20	1014.8
	45004	47.6N	086.5W	0733	3.3	1.4	0.5	3.3	05/21	7.5	W	29.3	05/19	1015.4
	45005	41.7N	082.4W	0463	12.3	10.1	0.2	0.2	31/11	6.4	SW	20.0	25/11	1014.7
	45006	47.3N	089.9W	0577	3.8	1.6	0.3	2.1	05/20	6.4	NE	25.5	05/12	1015.4
	45007	42.7N	087.1W	0737	9.5	3.9	0.5	1.9	10/01	7.8	N	20.0	25/04	1018.9
	45008	44.3N	082.4W	0443	4.3	2.2	0.6	2.0	07/23	9.4	N	22.2	07/12	1015.4
	46001	56.3N	148.3W	0738	5.6	6.1	2.0	5.3	15/22	10.6	W	26.9	15/15	1015.6
	46002	42.5N	130.4W	0736	11.1	12.2	2.1	4.0	18/09	12.2	NW	26.2	23/02	1022.8
	46005	46.1N	131.0W	0742	9.8	10.3	2.0	4.3	18/03	10.3	NW	23.3	27/22	1021.3
	46006	40.8N	137.6W	0733	11.9	13.0	1.9	3.9	23/05	12.2	SW	25.8	23/02	1025.5
	46010	46.2N	124.2W	0121	11.8	13.0	1.6	2.9	28/05	6.6	NW	22.0	26/19	1020.3
	46011	34.9N	120.9W	0730	12.4	12.2	2.1	3.8	12/04	15.1	NW	29.7	24/03	1017.1
	46012	37.4N	122.7W	0732	12.2	12.5	1.9	4.6	12/06	11.9	NW	27.7	28/04	1018.6
	46013	38.2N	123.3W	0734	11.6	11.2	2.0	3.6	28/08	18.4	NW	34.3	12/01	1017.2
	46014	39.2N	124.0W	0133	13.2	13.4	1.7	2.8	01/16	7.9	N	15.3	06/08	1019.1
	46022	40.8N	124.5W	0741	11.6	11.5	2.1	3.8	20/08	10.0	N	22.4	22/22	1019.7
	46023	34.3N	120.7W	0737	12.6	12.4	2.2	3.7	12/00	17.3	NW	28.0	24/10	1016.1
	46025	33.7N	119.1W	0513	15.2	16.8	1.2	2.7	11/08	7.1	W	27.0	11/02	1015.4
	46026	37.8N	122.7W	0741	11.4	11.2	1.6	3.7	12/03	14.5	NW	31.9	28/03	1017.2
	46027	41.8N	124.4W	0727	10.6	10.2	1.7	3.2	20/00	11.6	NW	30.7	31/03	1020.2
	46028	35.8N	121.9W	0737	13.0	13.6	2.3	4.3	12/12	17.0	NW	29.2	27/08	1017.5
	46030	40.4N	124.5W	0733	11.0	10.0	1.9	3.3	10/19	12.4	N	24.1	16/18	1018.9
	46035	57.0N	177.7W	0710	2.3	2.9	1.9	4.5	16/19	14.6	N	31.3	16/13	1012.7
	46040	44.8N	124.3W	0736	11.5	12.1	1.7	3.3	18/00	9.9	N	29.3	23/17	1019.8
	46041	47.4N	124.5W	0605	11.1	12.1	1.5	2.8	19/03	9.0	NW	22.0	17/17	1019.1
	46042	36.8N	122.4W	0739	12.2	12.5	2.1	4.5	12/05	13.4	NW	26.0	25/22	1018.8
	46125	33.7N	119.1W	0692			1.2	2.8	11/05					
	51001	23.4N	162.3W	0604	23.6	23.9	2.0	2.9	24/23	13.1	E	19.4	23/18	1019.2
	51002	17.2N	157.8W	0739	24.7	25.9	2.3	3.3	28/20	16.1	E	24.5	12/11	1015.8
	51003	19.2N	160.8W	0245	24.7	25.3	2.0	2.7	01/06	12.1	E	17.0	16/15	1016.8
	51004	17.5N	152.6W	0733	25.0	25.8	2.3	3.2	02/22	15.0	E	22.0	22/02	1016.4
	52005	8.6N	144.5E	0211						0.9	E	1.9	11/04	1010.1
C-Man	ALSN6	40.5N	073.8W	0736	13.7	11.4				12.9	SW	37.1	10/21	1014.1
	BURL1	28.9N	089.4W	0736	24.6									1015.9
	BUZM3	41.4N	071.0W	0730	11.8					14.4	SW	34.4	06/12	1014.7
	CARO3	43.3N	124.4W	0734	11.1					6.7	N	28.0	23/23	1020.4
	CHLV2	36.9N	075.7W	0733	17.0	16.4	0.8	2.1	06/07	13.1	S	36.4	06/06	1016.2
	CLKN7	34.6N	076.5W	0706	19.7					9.8	SW	23.1	28/14	1016.6
	CSBF1	29.7N	085.4W	0734	23.3					7.5	SW	21.4	10/13	1017.5
	DBLN6	42.5N	079.4W	0735	11.3					10.3	SW	33.6	07/19	1015.0
	DESW1	47.7N	124.5W	0707	10.8					9.1	NW	33.1	17/17	1018.8
	DISW3	47.1N	090.7W	0734	7.0					10.0	SW	44.0	25/02	1015.6
	DPIA1	30.3N	088.1W	0738	24.1	25.2				10.6	SE	26.8	01/12	1017.3
	DSLN7	35.2N	075.3W	0739	19.7	20.3	1.1	3.9	10/13	14.7	SW	42.7	02/10	1016.2
	FARP2	8.6N	144.6E	0729	28.2					10.0	E	22.1	12/18	1009.6
	FBIS1	32.7N	079.9W	0738	21.6					9.0	SW	28.3	02/02	1017.3
	FFIA2	57.3N	133.6W	0736	9.0					7.9	S	24.6	15/23	1017.3
	FPSN7	33.5N	077.6W	0737	21.0					13.6	SW	33.8	28/14	1016.8
	GDIL1	29.3N	090.0W	0736	25.2	26.4				10.6	S	27.2	01/05	1015.8
	GLLN6	43.9N	076.4W	0723	10.2					10.3	W	32.4	07/16	1014.0
	IOSN3	43.0N	070.6W	0730	11.5					14.5	S	35.4	27/18	1015.3
	LKWF1	26.6N	080.0W	0736	25.5	26.2				8.5	E	21.0	24/21	1016.8
	MDRM1	44.0N	068.1W	0712	8.0					13.0	SW	36.1	06/15	1014.7
	MISM1	43.8N	068.9W	0734	8.4					13.2	S	40.1	06/11	1014.6
	MLRF1	25.0N	080.4W	0738	26.3	27.2				9.5	E	21.3	01/05	1016.9
	MPCL1	29.4N	088.6W	0736	24.5					11.5	SE	31.6	01/04	1016.1
	NWPO3	44.6N	124.1W	0739	10.8					7.0	N	23.0	17/17	1019.9
	PILM4	48.2N	088.4W	0740	5.2					10.0	W	28.0	05/18	1015.6
	PTAC1	39.0N	123.7W	0737	10.6					10.3	N	24.0	12/01	1018.0
	PTAT2	27.8N	097.1W	0727	25.3					14.0	SE	28.0	05/06	1013.1
	PTGC1	34.6N	120.7W	0737	11.8					16.6	N	30.5	09/00	1017.1
	ROAM4	47.9N	089.3W	0726	4.6					11.5	NE	48.0	25/05	1016.6
	SAUF1	29.9N	081.3W	0736	23.0	24.2				8.7	E	22.1	28/22	1017.7
	SBIO1	41.6N	082.8W	0733	13.4					9.9	N	30.4	07/22	1014.9
	SGNW3	43.8N	087.7W	0732	9.2					9.1	S	29.6	25/04	1015.0
	SISW1	48.3N	122.8W	0740	10.3					9.4	W	35.1	18/04	1017.7
	SMKF1	24.6N	081.1W	0720	26.6	27.2				8.9	E	22.4	08/01	1017.5
	SPGF1	26.7N	079.0W	0726	25.8	27.4				6.1	E	16.4	19/00	1017.7
	SRST2	29.7N	094.1W	0658	24.8					12.4	S	34.3	03/21	1015.8

	Station	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
	MAY 1989													
	STDM4	47.2N	087.2W	0738	6.6					12.7	S	42.1	25/06	1015.1
	SULS1	32.0N	080.7W	0718	21.5	21.9				12.1	S	33.1	28/19	1016.9
	TPLM2	38.9N	076.4W	0738	16.5	15.7				10.4	S	31.5	06/04	1014.8
	TTIW1	48.4N	124.7W	0735	10.3					7.2	W	28.0	01/04	1019.3
	VENF1	27.1N	082.5W	0734	24.0	26.8				8.2	NW	21.5	01/21	1017.0
	WPOW1	47.7N	122.4W	0736	11.6					6.6	S	27.4	18/08	1018.0
	JUNE 1989													
Buoy	32302	18.0S	085.1W	0706	18.7	20.5	2.5	4.8	23/12	10.5	SE	20.8	27/15	1018.0
	41001	34.9N	072.9W	0716	25.6	26.8	1.4	3.6	10/07	12.1	SW	29.6	10/08	1020.0
	41002	32.2N	075.3W	0365	26.4	27.3	1.0	2.4	30/19	9.5	S	22.3	24/07	1018.3
	41006	29.3N	077.4W	0716	26.8	27.3	0.9	1.8	09/13	8.9	S	18.1	07/18	1019.1
	41008	30.7N	081.1W	0710	25.5	25.9	0.7	1.6	09/05	9.3	S	28.4	09/19	1017.5
	41009	28.5N	080.2W	1433	25.9	26.0	0.6	1.2	08/22	9.4	S	31.3	07/20	1019.2
	41010	28.9N	078.5W	1434	26.7	27.5	0.9	1.8	09/14	10.1	S	28.8	09/01	1019.4
	42001	25.9N	089.7W	0701	27.3	27.9	1.0	2.9	08/15	12.0	SE	26.2	06/21	1014.9
	42002	26.0N	093.5W	0714	27.1	27.7	1.2	2.9	23/08	12.1	S	23.7	30/14	1013.4
	42003	25.9N	085.9W	0709		27.7	1.0	2.8	09/10	9.7	SE	23.1	09/06	1016.6
	42007	30.1N	088.8W	0717	26.8	28.3	0.5	1.9	08/20	11.5	S	34.0	15/16	1016.3
	42015	30.2N	088.2W	0713	26.9	28.0	0.7	3.2	08/22	9.5	S	28.2	15/17	1016.0
	42016	30.2N	088.1W	0709	26.8	28.0	0.6	2.5	08/18	9.6	S	29.0	08/17	1015.6
	42017	27.9N	090.9W	0718	27.2	27.7				10.8	S	22.0	08/11	1014.7
	44004	38.5N	070.6W	0266	21.1	20.5	1.2	2.7	10/12	9.2	SW	21.3	13/15	1016.9
	44005	42.7N	068.6W	0719	13.6	12.8	1.0	2.9	10/11	7.2	SW	21.9	16/03	1016.1
	44007	43.5N	070.1W	0716	14.4	12.4	0.6	3.0	10/13	7.6	S	23.3	10/09	1015.1
	44008	40.5N	069.5W	0717	14.2	11.5	1.0	2.2	11/01	10.6	SW	22.2	13/15	1016.0
	44009	38.5N	074.6W	0717	21.8	20.8	0.7	1.4	10/02	9.5	S	21.4	17/01	1016.1
	44011	41.1N	066.6W	0471	12.4	11.3	1.4	3.2	11/03	8.2	SW	17.5	10/04	1015.0
	44013	42.4N	070.8W	0703	16.8	14.8	0.4	2.0	10/09	9.0	SE	21.0	11/18	1015.4
	45001	48.0N	087.7W	0718	4.9	2.9	0.5	1.9	08/05	8.0	SE	22.7	07/15	1015.4
	45002	45.3N	086.4W	0717	7.6	4.2	0.3	1.0	08/03	6.8	S	17.1	06/01	1015.0
	45003	45.3N	082.7W	0705	6.7	3.3	0.3	1.3	10/15	7.0	NW	21.8	03/07	1015.4
	45004	47.6N	086.5W	0715	4.5	2.5	0.4	1.6	07/22	7.6	SE	23.7	07/21	1016.2
	45005	41.7N	082.4W	0717	18.4	18.4	0.4	1.9	29/05	7.2	E	24.5	03/20	1014.7
	45006	47.3N	089.9W	0639	5.8	2.8	0.5	2.7	13/17	7.0	SW	24.9	13/19	1014.9
	45007	42.7N	087.1W	0706	12.7	10.9	0.4	2.2	28/21	7.1	S	21.2	29/00	1015.7
	45008	44.3N	082.4W	0698	10.0	7.6	0.3	1.0	10/17	6.8	NE	18.5	28/16	1015.1
	46001	56.3N	148.3W	0718	7.9	8.0	1.8	4.7	03/15	10.9	W	23.2	02/12	1014.9
	46002	42.5N	130.4W	0714	12.6	13.2	2.3	4.4	23/10	13.3	N	25.6	23/09	1021.2
	46005	46.1N	131.0W	0717	11.5	11.8	2.2	3.8	17/09	12.7	N	23.7	17/05	1020.7
	46006	40.8N	137.6W	0712	13.5	14.5	2.0	3.4	14/18					1023.7
	46010	46.2N	124.2W	0717	13.4	13.8	1.8	4.0	30/21	10.2	NW	37.9	30/19	1017.8
	46011	34.9N	120.9W	0716	13.0	12.5	1.7	3.5	20/17	12.0	NW	26.2	13/22	1015.0
	46012	37.4N	122.7W	0715	12.8	12.9	1.6	3.3	20/05	10.0	NW	27.5	20/06	1016.3
	46013	38.2N	123.3W	0717	11.7	10.4	1.8	3.7	21/03	13.5	NW	33.4	09/18	1014.9
	46014	39.2N	124.0W	0329	12.3	11.5	2.0	3.9	20/22	12.2	NW	28.6	20/23	1015.0
	46022	40.8N	124.5W	0717	12.0	11.6	2.2	5.3	23/06	8.7	N	25.0	30/00	1016.8
	46023	34.3N	120.7W	0699	13.5	13.1	1.9	3.5	20/10	14.3	NW	27.4	12/21	1014.0
	46026	37.8N	122.7W	0717	12.0	11.7	1.4	2.8	20/07	11.5	W	29.1	20/02	1015.0
	46027	41.8N	124.4W	0709	10.7	9.3	1.9	4.4	23/04	10.4	NW	34.6	23/01	1017.5
	46028	35.8N	121.9W	0718	13.7	13.4	2.0	3.7	20/10	13.3	NW	28.3	14/06	1014.8
	46030	40.4N	124.5W	0720	11.1	9.5	1.9	4.1	23/06	11.5	N	26.8	29/23	1016.0
	46035	57.0N	177.7W	0693	4.8	5.3	1.2	3.0	20/00	11.7	N	24.9	07/17	1014.8
	46040	44.8N	124.3W	0719	13.1	13.2	1.9	4.0	26/23	11.0	N	29.7	30/04	1018.2
	46042	36.8N	122.4W	0717	13.2	13.8	1.8	3.9	21/09	12.7	NW	26.8	18/00	1016.3
	46125	33.7N	119.1W	0683			1.0	1.7	20/13					
	51001	23.4N	162.3W	0716	24.8	25.4	1.8	3.1	04/18	11.8	E	19.1	29/21	1018.7
	51002	17.2N	157.8W	0714	25.0	26.0	2.1	3.2	10/16	14.8	E	21.7	11/04	1016.0
	51003	19.2N	160.8W	0239	25.6	26.4	1.8	2.7	05/03	11.5	NE	20.7	23/18	1016.7
	51004	17.5N	152.6W	0716	25.2	26.0	2.0	3.1	05/19	14.1	E	23.4	10/12	1016.7
C-Man	ALSN6	40.5N	073.8W	0713	20.1	17.4				10.6	SW	28.0	04/00	1014.9
	BURL1	28.9N	089.4W	0718	26.4					12.0	SE	25.6	22/15	1014.8
	BUZM3	41.4N	071.0W	0707	17.0					12.1	SW	27.8	15/21	1015.2
	CARO3	43.3N	124.4W	0713	11.9					7.5	N	26.2	30/20	1018.4
	CHLV2	36.9N	075.7W	0707	23.4	21.6	0.7	1.8	13/01	12.1	SW	31.1	13/04	1017.1
	CLKN7	34.6N	076.5W	0697	25.1					10.7	SW	23.2	29/23	1018.6
	CSBF1	29.7N	085.4W	0708	26.6					7.9	S	26.3	09/06	1017.1
	DBLN6	42.5N	079.4W	0714	18.1					7.7	SW	34.4	01/04	1015.9
	DESW1	47.7N	124.5W	0681	12.7					9.6	NW	36.1	23/00	1017.3
	DISW3	47.1N	090.7W	0717	11.5					9.7	NE	34.1	07/13	1015.4
	DPIA1	30.3N	088.1W	0717	26.8	28.4				9.2	S	29.9	08/20	1016.5
	DSLN7	35.2N	075.3W	0717	24.8	24.5	1.0	2.7	14/03	15.3	SW	34.4	10/00	1017.5
	FARP2	8.6N	144.6E	0711	27.8					7.5	E	25.7	01/21	1010.6
	FBIS1	32.7N	079.9W	0714	26.2					10.1	SW	26.9	09/06	1018.0
	FFIA2	57.3N	133.6W	0718	11.6					6.2	N	24.8	18/06	1018.7
	FPSN7	33.5N	077.6W	0717	25.3					12.9	SW	30.9	10/03	1017.9
	GDIL1	29.3N	090.0W	0705	27.2	28.5				10.3	S	26.0	14/19	1015.0
	GLLN6	43.9N	076.4W	0708	16.4					9.0	SW	29.0	10/19	1015.1
	IOSN3	43.0N	070.6W	0717	16.1					11.0	S	28.6	11/15	1016.4
	LKWF1	26.6N	080.0W	0713	26.6	27.4				8.7	SE	24.0	07/23	1018.2
	MDRM1	44.0N	068.1W	0707	11.3					11.3	SW	30.0	10/12	1015.0
	MISM1	43.8N	068.9W	0716	12.1					11.1	SW	36.1	10/11	1015.2
	MLRF1	25.0N	080.4W	0715	27.3	28.2				10.9	SE	23.9	28/17	1018.1
	MPCL1	29.4N	088.6W	0713	26.6					11.3	S	37.1	08/18	1015.3
	NWPO3	44.6N	124.1W	0713	12.3					7.7	N	28.0	30/19	1018.1
	PILM4	48.2N	088.4W	0711	6.4					10.4	NE	26.8	07/16	1016.5
	PTAC1	39.0N	123.7W	0548	11.0					9.7	N	27.0	23/20	1015.4
	PTAT2	27.8N	097.1W	0711	26.8					13.9	SE	28.0	14/11	1012.4
	PTGC1	34.6N	120.7W	0538	12.7					15.7	N	29.8	09/07	1014.5
	ROAM4	47.9N	089.3W	0700	6.6					13.2	NE	33.1	07/20	
	SAUF1	29.9N	081.3W	0716	25.1	25.4				7.6	S	20.5	09/02	1018.5
	SBIO1	41.6N	082.8W	0712	19.9					7.9	E	30.0	10/02	1015.1
	SGNW3	43.8N	087.7W	0704	14.5					8.1	N	24.6	28/15	1014.8
	SISW1	48.3N	122.8W	0716	12.5					7.8	W	24.0	09/01	1017.4
	SMKF1	24.6N	081.1W	0697	27.5	27.8				10.7	SE	21.4	28/02	1018.5
	SPGF1	26.7N	079.0W	0717	26.8	28.5				4.6	S	14.8	02/02	1019.1
	SRST2	29.7N	094.1W	0622	26.6					14.5	S	33.8	27/05	1014.5
	STDM4	47.2N	087.2W	0709	8.8					13.3	S	34.1	08/18	1015.8
	SULS1	32.0N	080.7W	0682	25.9	27.0				12.3	S	31.9	09/17	1017.8
	TPLM2	38.9N	076.4W	0715	23.6	23.2				8.7	S	31.0	16/00	1015.8
	TTIW1	48.4N	124.7W	0699	12.1					9.1	S	31.0	16/21	1017.9
	VENF1	27.1N	082.5W	0712	26.1	29.7				7.7	E	22.9	30/20	1017.7
	WPOW1	47.7N	122.4W	0713	14.5					6.9	NE	21.0	26/08	1016.7

PEARL HARBOR, HAWAII, U.S.A.

CALL SIGN	FREQUENCIES	TIMES	EMISSION	POWER
NPM	2122 kHz USB	0600-1600 (*)	F3C	
		4855 kHz LSB/ISB	CONTINUOUS(*)	F3C
		8494 kHz USB	CONTINUOUS(*)	F3C
		9090 kHz ISB	CONTINUOUS(&)	F3C
		9396 kHz USB/ISB	CONTINUOUS(*)	F3C
		14826 kHz USB/ISB	CONTINUOUS(*)	F3C
		21837 kHz USB/ISB	1700-0630 (*)	F3C

(*)PEARL HARBOR FREQUENCIES (*)ADAK AK FREQUENCY (&)STOCKTON CA FREQUENCY

TRANS TIME	CONTENTS OF TRANSMISSION	RPM/IOC	VALID	MAPTIME	AREA
0000/----	FFAX SCHEDULE (WED & SAT)		120/576	--/--	-
	SEA SURFACE TEMP ANAL (HAWAII AREA) (SUN)		120/576	--/12	6
	SEA SURFACE TEMP ANAL (SWPAC) (TUE)		120/576	--/12	7
	SEA SURFACE TEMP ANAL (SOCAL) (THU)		120/576	--/12	8
	SONIC LAYER DEPTH (WPAC) (FRI)		120/576	--/12	1
/1200	48HR SIGNIFICANT WAVE PROG		120/576	00/--	2
0015/----	FFAX SCHEDULE (WED & SAT)		120/576	--/--	-
	SEA SURFACE TEMP ANAL (NOCAL) (SUN & THU)		120/576	--/12	9
	SEA SURFACE TEMP ANAL (NWPAC) (MON)		120/576	--/12	10
	OPEN PERIOD (TUE)				
	SONIC LAYER DEPTH (EPAC) (FRI)		120/576	--/12	2
/1215	SATELLITE IMAGERY (IR)	120/576	1159	-	
0030/----	SATELLITE IMAGERY (VISUAL)	120/576	2359	-	
/1230	OPEN PERIOD				
0045/1245	SIGNIFICANT WAVE H-VIS ANAL	120/576	12/00	3	
0100/1300	12HR SURFACE PROG	120/576	00/12	4	
0115/1315	24HR SURFACE PROG	120/576	12/00	4	
0130/1330	24HR 850MB PROG	120/576	12/00	2	
0145/1345	24HR 700MB PROG	120/576	12/00	2	
0200/1400	24HR 400MB PROG	120/576	12/00	2	
0215/1415	24HR 300MB PROG	120/576	12/00	2	
0230/1430	PRELIM SURFACE ANAL (EAST)	120/576	00/12	2	
0245/1445	PRELIM SURFACE ANAL (WEST)	120/576	00/12	1	
0300/1500	24HR SIGNIFICANT WAVE PROG	120/576	12/00	1	
0315/1515	48HR SIGNIFICANT WAVE PROG	120/576	12/00	1	
0330/1530	24HR 850MB PROG	120/576	12/00	1	
0345/----	FFAX SATELLITE PANEL (WEST PAC)	120/576	0328	-	
/1545	FFAX SATELLITE PANEL (WEST PAC)	120/576	1528	-	
0400/1600	24HR 700MB PROG	120/576	12/00	1	
0415/1615	24HR 400MB PROG	120/576	12/00	1	
0430/1630	24HR 300MB PROG	120/576	12/00	1	
0445/1645	24HR SIGNIFICANT WAVE H-VIS PROG	120/576	12/00	3	
0500/1700	48HR SIGNIFICANT WAVE H-VIS PROG	120/576	12/00	3	
0515/----	24HR 500MB SL PROG	120/576	12/--	3	
/1715	72HR SURFACE PROG	120/576	--/00	2	
0530/----	48HR 500MB SL PROG	120/576	12/--	3	
/1730	72HR SURFACE PROG	120/576	--/00	1	
0545/1745	TROPICAL WARNINGS/OPEN PERIOD	120/576	--/00	-	
0600/1800	FINAL SURFACE ANAL	120/576	00/12	5	
0645/----	SATELLITE IMAGERY (IR)	120/576	0529	-	
/1845	SATELLITE IMAGERY (VISUAL)	120/576	1759	-	
0700/1900	500MB ANAL	120/576	00/12	2	
0715/1915	500MB ANAL	120/576	00/12	1	
0730/1930	OPEN PERIOD				
0745/1945	24HR SURFACE PROG	120/576	00/12	2	
0800/2000	24HR SURFACE PROG	120/576	00/12	1	
0815/2015	48HR SURFACE PROG	120/576	00/12	2	
0830/2030	48HR SURFACE PROG	120/576	00/12	1	
0845/2045	PRELIM SURFACE ANAL (EAST)	120/576	06/18	2	
0900/2100	PRELIM SURFACE ANAL (WEST)	120/576	06/18	1	
0915/----	SATELLITE IMAGERY (IR)	120/576	0859	-	
/2115	SATELLITE IMAGERY (FULL DISK WATER VAPOR)	120/576	2044	-	
0930/2130	OPEN PERIOD				
0945/2145	24HR 500MB PROG	120/576	00/12	2	
1000/2200	24HR 500MB PROG	120/576	00/12	1	
1015/2215	36HR SURFACE PROG	120/576	00/12	2	
1030/2230	36HR SURFACE PROG	120/576	00/12	1	
1045/2245	48HR 500MB PROG	120/576	00/12	2	
1100/2300	48HR 500MB PROG	120/576	00/12	1	
1115/----	OPEN PERIOD				
1130/2315	SIGNIFICANT WAVE H-VIS ANAL	120/576	00/12	2	
1145/2330	24HR SIGNIFICANT WAVE PROG	120/576	00/12	2	
/2345	48HR SIGNIFICANT WAVE PROG	120/576	--/12	2	

MAP AREAS: CHART PROJECTION ASSUMES A 19 INCH RECORDER.

1 - 1:13,000,000 60N 123E, 60N 162W, 05N 123E, 05N 162W
2 - 1:13,000,000 60N 168W, 60N 093W, 05N 168W, 05N 093W
3 - 1:05,000,000 38N 100E, 42N 080W, EQ 160E, EQ 140W
4 - NOT AVAILABLE
5 - 1:13,000,000 60N 150E, 60N 110W, 05N 150E, 05N 110W
6 - 1:05,000,000 12N 170W, 40N 170W, EQ 145W, 30N 135W
7 - 1:05,000,000 EQ 170E, 34N 160E, 05N 165W, 38N 165W
8 - 1:05,000,000 25N 135W, 45N 120W, 15N 120W, 25N 105W
9 - 1:05,000,000 35N 170W, 65N 170W, 30N 140W, 50N 115W
10 - 1:05,000,000 30N 160E, 50N 135W, 30N 165W, 65N 165W

NOTES: 1. CONTENTS OF THIS SCHEDULE MAY CHANGE WITHOUT NOTICE DUE TO U.S. NAVY OPERATIONAL REQUIREMENTS.
2. COMMENTS CONCERNING QUALITY AND CONTENT ARE SOLICITED. ADDRESS COMMENTS TO:

NAVAL WESTERN OCEANOGRAPHY CENTER
BOX 113
PEARL HARBOR, HI 96860-5050

(INFORMATION DATED 09/1989)

Northwest England
Mr. W.G Cullen, Master Mariner,
PMO, Room 218
Royal Liver Building
Liverpool L3 1HU
Tel: 051 236 6565

Scotland and Northern Ireland
Captain S.M. Norwell, PMO
MOD(N) Room 200F, Navy Buildings
Eldon Street, Greenock
Strathclyde PA16 7SL
Tel: 0475 24700

Bristol Channel
Captain J.H. Jones, PMO
Cardiff Weather Centre
Southgate House, Wood Street
Cardiff CF1 1EW
Tel: 0222 21423

Southwest England
Captain D.R. McWhan, PMO
Southampton Weather Centre
160 High Street
Southampton S01 OBT
Tel: 0703 20632

Southeast England
Captain C.R. Downes, PMO
Daneholes House
Hogg Lane
Grays, Essex RM17 5QH
Tel: 0375 78369

Northeast England
Captain D.H. Rutherford, PMO
Room D622, Corporation House
73–75 Albert Road
Middlesbrough, Cleveland TS1 2RU
Tel: 0642 241144, ext. 275

Atlantic Ports

Mr. Peter Connors, PMO
National Weather Service, NOAA
1600 Port Boulevard
Miami, FL 33132
305-358-6027

Mr. Lawrence Cain, PMO
National Weather Service, NOAA
Jacksonville International Airport
Box 18367
Jacksonville, FL 32229
904-757-1730 (FTS 946-3620)

Mr. Earle Ray Brown, Jr., PMO
National Weather Service, NOAA
Norfolk International Airport
Norfolk, VA 23518
804-441-6326 (FTS 827-6326)

Mr. Robert Melrose, PMO
National Weather Service, NOAA
Weather Service Office
BWI Airport
Baltimore, MD 21240
301-962-2177 (FTS 922-2177)

John Warrelman, PMO
National Weather Service, NOAA
Building 51
Newark International Airport
Newark, NJ 07114
201-850-0529 (FTS 341-6188)

Dee Letterman, PMO
National Weather Service, NOAA
30 Rockefeller Plaza
New York, NY 10112
212-399-5569

Mr. Michael McNeil
Atmospheric Environment Service
1496 Bedford Highway
Bedford, (Halifax) Nova Scotia
B4A 1ES
902-426-9225

Mr. Denis Blanchard
Atmospheric Environment Service
100 Alexis Nihon Blvd., 3rd Floor
Ville St. Laurent, (Montreal) Quebec
H4M 2N6
514-283-6325

Mr. D. Miller, PMO
Atmospheric Environment Service
Bldg. 303, Pleasantville
P.O. Box 9490, Postal Station "B"
St. John's, Newfoundland
A1A 2Y4
709-772-4798

Pacific Ports

Mr. Peter Celone, W/PRx2
Pacific Region, NWS, NOAA
Prince Kuhio Fed. Bldg., Rm 411
P.O. Box 50027
Honolulu, HI 96850
808-541-1670

Mr. Robert Webster, PMO
National Weather Service, NOAA
2005 T Custom House
3005 South Ferry Street
Terminal Island, CA 90731
213-514-6178 (FTS 795-6178)

Robert Novak, PMO
National Weather Service, NOAA
Coast Guard Island Bldg. 10
Alameda, CA 94501
415-273-6257 (FTS 536-6257)

Mr. David Bakeman, PMO
National Weather Service, NOAA
7600 Sand Point Way, N.E.
BIN C15700
Seattle, WA 98115
206-526-6100 (FTS 392-6100)

Mr. Ron McLaren, PMO
Atmospheric Environment Service
700-1200 W. 73rd Av.
Vancouver, British Columbia
V69 6H9
604-666-0360

Mr. Robert Bonner, OIC
National Weather Service, NOAA
Kodiak, AK 99619
Box 37, USCG Base
907-487-2102/4338

Mr. Lynn Chrystal, OIC
National Weather Service, NOAA
Box 427
Valdez, AK 99686
907-835-4505

Marine Program Mgr. W/AR121x3
Alaska Region, National Weather Service
222 West 7th Avenue #23
Anchorage, AK 99513-7575
907-271-5121 (FTS 271-5121)

Great Lakes Ports

Mr. Bob Collins, PMO
National Weather Service, NOAA
10600 West Higgins Road
Rosemont, IL 60018
312-353-4680 (FTS 353-4680/2455)

Mr. George Smith, PMO
National Weather Service, NOAA
Hopkins International Airport
Federal Facilities Bldg.
Cleveland, OH 44135
216-267-0069 (FTS 942-4949/4517)

Port Meteorological Officer
Atmospheric Environment Service
25 St. Clair Av. East
Toronto, Ontario
M4T 1M2
416-973-5809

Mr. Ronald Fordyce
Atmospheric Environment Service
Federal Building
Thorold, Ontario
L2V 1W0
416-227-0238

Gulf of Mexico Ports

Mr. Jim Downing, PMO
National Weather Service, NOAA
Int'l Airport, Moisant Field, Box 20026
New Orleans, LA 70141
504-469-4648 (FTS 682-6694)

Mr. James Nelson
National Weather Service, NOAA
Route 6, Box 1048
Alvin, TX 77511
713-331-0450

Headquarters

Mr. Vincent Zegowitz
Marine Obs. Program Leader
National Weather Service, NOAA
8060 13th St.
Silver Spring, MD 20910
301-427-7724 (FTS 427-7724)

Mr. Martin Baron
VOS Program Manager
National Weather Service, NOAA
8060 13th St.
Silver Spring, MD 20910
301-427-7724 (FTS 427-7724)

Mr. George Payment
Marine Meteorological Officer (AWDH)
Atmospheric Environment Service
4905 Dufferin St.
Downsview, Ontario
M3h 5T4
416-739-4942

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
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National Oceanographic Data Center
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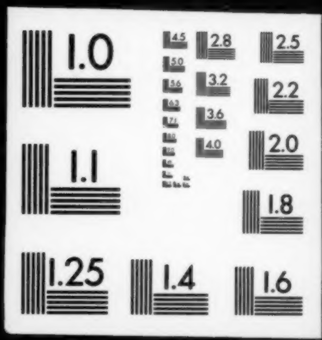
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